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THE LILY IN THE MILLET PATCH

A case study of community development Socio Technical problems in the supply of clean water in Ghana West Africa

Ⓒ

by

ROY J V PALLANT

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
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Arthur K. Davis
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John Young

Date September 24, 1984

ABSTRACT

Behind most projects involving aid to developing nations, over the past thirty-five years, there is strong evidence of donor countries adopting, at least implicity, an ideology of paternalism, social control and non-reciprocity between donor and recipient at the grass-roots level. If there is to be change there must be dialogue, and this must take a cybernetic form.

In 1974, the Canadian International Development Agency (CIDA) launched the Ghana Upper Region Water Supply Project (#400/00604, Unit 001, Phases I and II) as a continuation of the provision of hand-operated water pumps in rural areas, and the provision of a pipe-borne urban pressure supply system. The whole scope of the specification, issued for consultant/contractor tendering, was restricted to a technical viewpoint which resulted in the loss of time and funding for studying and adapting equipment and its installation to suit the application as seen from the social aspects, already long in place. Negotiations were between the consultant/contractor from Canada, and the Ghana Water and Sewage Corporation (GWSC) whose staff was from Southern Ghana and therefore alien to the nature and customs of the recipient people; therefore, again, while a cybernetic approach to GWSC was developed, the actual site conditions were revealed in due course rather than planned

ACKNOWLEDGEMENTS

While contained in the foundations of this study there is a sound and much-appreciated training in Community Development at the University of Alberta, many years of technical training, and professional association with people and their problems, make those individuals who I must acknowledge very clear in my thoughts.

I thank Dr. Sami Mohsen for the excellence of the Community Development study program content; the staffing; and Dr. Mohsen's consistent, high-quality and impartial administration.

I respectfully thank Dr. John Young for pointing out that cybernetics, applied sociologically, is not as well understood in aid programs as I had first assumed.

Special thanks go to Dr. Art K. Davis as chairman for this study; more especially for his consistent efforts to ensure that this study remain, in form and language, accessible to all, academic or otherwise, for useful understanding and essential application.

Thanks must go to the management and staff of Wardrop and Associates, Winnipeg, for their outstanding cooperation and supportive attitude towards the success of this study and the project; to the CIDA officials in Hull; and to the cooperants in Ghana for providing information and friendly access.

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CHAPTER I
INTRODUCTION

THE PROBLEM

The development programs, provided by donor nations which are hungry for government handouts, have been consistently attacked for, in fact, providing greater benefits to themselves, rather than the recipient nation. Figures regularly published by CIDA indicate that about 50% of aid funds appropriated are spent in Canada, buying supposedly Canadian goods, and certainly creating jobs for Canadians. It is argued by CIDA that, if Canadian goods and services are competitively priced and meet the real needs of large numbers of poor people in the developing country, the benefits to Canadians do not dilute the usefulness of the project.

Further, in the 1970s, there was a growing world consensus supporting a basic-needs strategy that gives first priority to meeting the immediate needs of the poor majority for food, safe water, shelter, and basic education and health care. Certainly, this strategy is far more complex than the traditional project, usually negotiated with the elite class of the recipient country. Greater involvement with the poor becomes essential and this, as CIDA officials have admitted, means that projects must transcend all the social, political, and economic language and cultural differences, that exist between Canadians and the recipient poor of a target country or region.

It is, therefore, the degree to which CIDA and its appointed consultants and contractors succeed in carefully shaping a program of social development that puts people first; and that places the appropriate technology properly installed; and with parts and service firmly in place to avoid failure of the project by neglect; that will decide who benefits from a CIDA aid program and a Canadian tax payers' billion-dollar investment.

The Purpose of the Study:

This study intends to discuss and constructively criticize CIDA Project 400/00601 - the Ghana Upper Region Water Supply Project (initiated in Ghana, West Africa in 1974), together with related CIDA Projects 400/00134 and 400/0604, Unit 001, Phases I and II.

It may be said that there is an apparent misappropriation and potential misappropriation and mismanagement of Canadian public funds by the Canadian International Development Agency (CIDA), by way of insufficient study by CIDA (or its delegated consultants) of the recipient community areas at the grass-roots level. Had planning been done, the successful tendering consultant/contractor for the Upper Region Water Supply Project would have been made aware of the adherent problems, plan and budget accordingly, and apply a cybernetic approach at an early point in the execution of the project.

Method and Sources of this Study:

Information has been drawn from unpublished material contained in the files of CIDA offices in Hull, Quebec, a Canadian engineering consultant in Winnipeg, and the Canadian offices of a multi-national diesel generating set supplier. As an executive of this supplier company, this study is in fact the author's personal record of the transactions of this project as it has progressed over the past five years, and with a deep hands-on community development and problem-solving involvement for two periods domiciled in the area of study.

The thesis will be written from an inter-disciplinary viewpoint encompassing, by necessity, the essential combination of engineering, sociological, and commercial aspects, without which the project could not have been sucessfully coordinated. The study will, furthermore, be presented in language which the author feels most suited to convey the urgent nature of the concerns expressed and the needs of recipient communities.

The author, having been directly and indirectly involved in a number of overseas community development projects completed by his company over the past thirty years, considers this project to be typical in respect to problems, errors and omissions. What, however, is atypical here is the opportunity for interested individuals to be made aware of those same factors which are otherwise lost to renewed maintenance and innovative learning being dormant in the memories and diaries of laid-off or transferred members of some redundent project team; discarded after microfilming of major documents or, at best, hidden forever among the mass of stored project working files.

This study is, therefore, being offered as an expanded case-history, with analysis and discussion of the problems, both technical and social, involved at the planning, supply and application phases of the project. Included in the study is the manner in which problems were overcome.

Significance of this Study to Community Development:

In such a category this study should be of interest to concerned national and regional level government officials and employees; non-government agencies (NGAs); consulting engineers and suppliers; all of whom are seeking to improve their commitments and responsibility in overseas development projects which are aimed at supplying equipment suited in design, performance, to a given site; and the long-term benefit of the community involved.

This work will also be particulary enlightening to the student who -

a. genuinely intends to utilize and apply his or her Community Development training for application in the field for the benefit of the people involved in the fruits or frustrations of a development project, whether in Canada or overseas.

b. has conceived the impression in the process of study that being conversant and articulate in the philosophical arguments of so-called, 'development experts', is the solution to the actual problems found in concerned community development.

c. feels secure in the knowledge that professional consultant and government agencies are, after nearly forty years of overseas aid experience, very capable of administrating a successful overseas project to the true improvement of the recipient communities.

Limitations of this Study:

This study does not include discussion or recommendations for -

a. further development in the subject sites beyond the sectoral limitations of water supply for the purpose of achieving community health;

b. changes in national and regional government policy with regard to transient labor, trade union movement, tribal transmigration;

c. social, cultural, political or economic development and conditions on a national or regional level.

It is the author's view that the formulation of aggregate policies for Community Development, without careful analysis for spurious factors, is a false approach, therefore, comparisons with other projects manifesting similar problems are not discussed.

CHAPTER II

GHANA

A BRIEF DESCRIPTION OF NATIONAL FEATURES

GEOGRAPHY

Location and Size:

Ghana is situated on that part of Africa's west coast, formerly known as the Gold Coast. It extends northward, from the Gulf of Guinea, for some 420 miles, and is 334 miles at its widest. With an area of 92,100 square miles (238,533 square kilometers), it is slightly larger than southern Ontario. On Ghana's eastern border lies Togo; to the west and north, respectively, lie the French language states of the Ivory Coast and Upper Volta.

Physical Features:

Ghana consists of three basic physiographic regions: the dissected forest plateau of the south and southwest; the southeast coastal plains; and the northern plains and Volta basin. The southern plateau is formed of ancient pre-Cambrian rock, similar to that of the Canadian Shield, which has been worn down to a pereplain and is now dissected by rivers and streams. The Voltaian basin was formed by a hugh paleozoic interior lake which laid down horizontal layers of sandstone and shales.

The southeast coastal plains comprise a relatively undisturbed pre-Cambrian formation over which sedimentary deposits later accumulated.

The most striking physical features in the country are the Akwapim-Togo ranges which reach an average elevation of 1,500 feet, and the Volta river which is one of Africa's major rivers. The Akwapim-Togo ranges separate the coastal plains from the interior basin of the Volta and are composed of young pre-Cambrian rocks, extremely folded with volcanic intrusions. The Volta river itself has a drainage area of 150,000 square miles, of which 40% is within Ghana. A major dam and power station, on the Akwapim-Togo ranges at Akosombo, has created the huge, man-made Lake Volta, 200 miles in length and about 3,275 square miles in area.

The northeast tradewinds, or "harmattan", are influenced by the hot, dry air of the Sahara continental tropical source region. These very dry, warm winds are responsible for the intense dry season experienced most pronouncedly in the Upper and Northern Regions of Ghana. As a result, there is a definite rainy season (March to August), and a dry season (October to February). The south, however, experiences a second rainfall in September and October.

An anomaly to this pattern is the southeast coastal plains which are the driest parts of the country (annual rainfall is only 30 inches). In addition to being sheltered from the tradewinds by the Akwapim-Togo ranges and southwest plains, the flatness of the coastal plains offers no rainfall features.

Climate and physiography have combined to produce distinct soil formations and thus vegetational patterns. Ghana has latosolic soils of the humid tropics which contain little humus and are subject to extreme leaching of nutrients. These soils will quickly loose fertility under crop cultivation, but will support luxuriant forests where conditions of high temperatures and rainfall prevail. Rainfall exceeds annual evaporation.

This is the case in the forest zone of the southern plateau region and Akwapim-Togo ranges. In the northern part of Ghana, to include the Upper and Northern Regions, however, the long, dry season and high temperatures bake the soil so that vegetation is limited to mainly savanna. The southeast coast has dense scrub vegetation, the sandy soils being in need of irragation to produce crops. In the Volta delta area, where soils are waterlogged and salty, strand and mangrove forests survive.

CLIMATE:

Overall, Ghana is classified as having a tropical, wet-dry climate (Koppen group AW). The annual mean temperature for the entire country is 79 to 84 degrees Farenheit, with no month below 64.4 degrees Farenheit. The principal factors behind this climatic regime is Ghana's equatorial position (400 miles from the equator) and the two associated wind systems that affect the country: the southwest (June to August) which brings in maritime equatorial air; and the northeast tradewinds (December to February), which bring continental tropical air from the sub-tropical, high-pressure cell.

The southwest tradewinds bring hot, humid weather with torrential rainfall on the plateau area of the south-southwest and the Akwapim-Togo ranges. In these regions, mid-day temperatures average more than 80 degrees Farenheit, and in the north, over 100 degrees Farenheit. Precipitation is heaviest on the southwest coast (over 70 inches of rainfall annually), and least in the Northern and Upper Regions where it becomes savanna with the parkland in local zones and climatic bands; rather similar to the prairie and parkland zones of Alberta.

HISTORY:

Ghana was settled largely by Sudanese Negroes migrating from the southern Sahara area between 700 and 1000 AD. According to legend, they were descendants of the builders of the ancient empire of Ghana which extended from the Niger bend to the Gambia river, and reached the height of its power about 1000 AD. At independence in 1957, the name "Ghana" was substituted for the country's colonial name, "Gold Coast", in recognition of this ancient connection.

European presence on the Guinea coast was first established by the Portuguese in the 15th century. Their forts and trading posts were soon joined by Dutch, British and Danish competitors seeking gold, kola nuts and later, slaves. In 1821, the British government assumed control of British trading settlements on the coast, and in 1844 a bond was signed with a number of local chiefs, legalizing and defining British jurisdiction in areas adjacent to the settlements.

By the latter half of the 19th century, Britain had established her sovereignty. A Crown colony was declared over the south in 1874, following the Ashanti defeat in the "Sagrenti War". In 1902, the Ashanti region, together with the protectorate of the Northern Territories, were incorporated into the colony. At the end of World War One, German Togoland was divided between Britain and France and "British Togoland" was then added to the eastern frontier.

During the first half of the twentieth century the colony of the Gold Coast was ruled by a governor, assisted by an executive and large legislative councils, centered in the capital, Accra. The British system of "indirect rule" did much to consolidate the power of the tribal chiefs into some two hundred political units, patterned after one of the four basic traditional organizational models: the Akan, Ga, Ewe (in the south), and the Moli-Dagbani groups of the north.

As constitutional advances were made and education was extended, African agitation for independence mounted under the leadership of the United Gold Coast Convention Party; its leaders, Joseph Danquah and Kwame Nkrumah, were imprisoned. Following his release in 1949, Nkrumah broke with Danquah and formed the Convention People's

Party (CPP), leading a campaign of civil disobedience against the British.

In the 1950s the independence movement continued to be dominated by Kwame Nkrumah, a strong, compelling new leader educated in the United States and Britain. His party's success was partly attributable to the fact that it significantly cut across ethnic-tribal divisions. This was enhanced by the common opposition of the people to British rule. The CPP won the 1956 general election, and on this basis received the grant of Ghanaean independence on March 6th, 1957. Ghana became the first colony in Africa to gain its independence from a colonial power.

In 1960 Ghana became a republic in the Commonwealth, with Nkrumah proclaimed as president, and "Osaguefo" (victorious leader or redeemer) was given the power to rule by decree. However, the period of Nkrumah's rule (1957 to 1966) quickly degenerated into political oppression and economic mismanagement. By 1965 Ghana had a budget deficit of thirty million dollars; basic goods were scarce and expensive and large segments of Ghanaean society became alienated and frustrated. A military coup in 1966 easily deposed Nkrumah who found refuge in Guinea. He died in 1972.

The military government of the National Liberation Council (NLC) surprisingly handed power back to a new civilian government under Dr. K.A. Busia in 1969. This regime, like the previous NLC, was less inclined towards Nkrumah's state socialism and adopted policies favorable to Western governments and their business community. However, they proved equally unable to solve Ghana's staggering economic difficulties - foreign indebtedness, perennial trade imbalances, and chronic difficulties in agriculture.

Again, the deterioration of economic conditions culminated in a bloodless military coup led by Colonel Ignatius K. Acheampong on January 13th, 1972. This government, the National Redemption Council (NRC), initiated a major economic reform program, adopted a strict "non-alignment" foreign policy, and generally ruled with a tough but not brutal hand. However, the world economic recession; the major drop in cocoa prices, which accounted for 75% of Ghana's foreign exchange earnings; and the continued suspension of political activity; resulted in a large campaign of civil disobedience in July and August, 1977.

This revolt, led by students, intellectuals and professionals, did not only manage to force a pledge from the government to return to constitutional rule, but it also led to a palace coup d'etat. General Acheampong was forced out of office and replaced by his second-in-command, General Akuffo. Furthermore, he was stripped of his military titles and confined to his village. However, this did not please the junior military officers. To them, Acheampong demanded a more drastic punishment than that for tarnishing the image of the Ghanaean army through his active participation in corrupt practises. These junior officers, under Flight Lieutenant J.J. Rawlings, successfully staged a coup on June 4th, 1979. Acheampong, Akuffo, Afrifa (all former military heads-of-state), and five other top-ranking military officers, were executed by firing squad.

This government, the Armed Forces Revolutionary Council (AFRC), handed power back to a democratically elected government under a constitution modelled along that of the United States. The executive president and his cabinet can not hold parliamentary seats. On Thursday, December 31st, 1981, J.J. Rawlings successfully staged a second coup, and remains tenuously in power at this time.

POPULATION

Size:

The population of Ghana is estimated to be about ten million, with over 66% under the age of twenty-five. It is growing at about 2.7% annually, but in the larger cities the rate is two-to-three times as much.

Within Ghana, the population is concentrated in three areas: the coastal cities; the southeastern and Ashanti regions, especially around the Ashanti, capital of Kumasi; and small concentrations of people in the far northeast, northwest, and around the city of Tamale. This pattern reflects that of the country's early economic development: along the coast, the commercial and mining centers; the spread of the cocoa plantations through the eastern and Ashanti regions; and in the north, the existence of relatively stable, military societies which resisted invasions and waves of migration.

Most of Ghana's population is agrarian with about 70% still living in small rural settlements. However, such urban areas as Accra, Kumasi, Tema, Sekondi-Takoradi, Cape Coast; and in the north, Tamale; stand in marked contrast to this.

Ethnic Origins:

The great majority of Ghana's people are Sudanese Negroes. They are divided into four major ethnolinguistic groups which form the four basic traditional organizational and political systems: the Akan, the Ga, the Ewe, and the Moli-Dagbani groups in the north.

The Akans account for 44% of the total population and are found mostly in the south. The Ashanti, Fanti, Boron, Akim, Nzima, Akwapim, or Kwahu, are sub-groups of the Akan. The most significant development among this group was the emergence of a pan-Akan movement at the end of the 1960s and the early 1970s which sought to dissolve the traditional iter-tribal hostilities and suspicions.

Unlike the Akans, who originally migrated from the southern Sahara area, the two other ethnic groups in the south, the Gas and Ewes, came from the east. The The Gas and Adangbes settled around Accra, and the Ewes in the Volta region.

The northern part of Ghana possesses a greater number of different ethnic groups than the south, but accounts for only 20% of the country's population. The principal group is the Mossi-Dagombas, but there is also the Dagombas, Mamprussis, Gonjas, etc. Each major tribe differs from one another in language, traditions, beliefs, and customs. Yet recently there has emerged a new pan-Northerner identity, originating from their perceived disadvantaged economic position compared to the south.

It is important to note that these ethnic divisions continue to play an important role in Ghanaean society. Unlike the earlier times, ethnic competition today is not concerned with restoring the chiefs and traditional states, but instead is used as a means of control of power and access to resources, jobs and prestige at the center of national government.

Religion:

In Ghana the three major religious groups are Christians, Traditionalists and Muslims. These represent 43%, 38% and 12% of the population respectively. Christianity predominates in the south, while in the north, Traditional beliefs and Islam are more common.

Traditional beliefs and practises are still fairly widely accepted among the population at large. These beliefs are characterized by spirit worship, ancestor veneration, and the concept of the extended family. The prime concern and motivation is the maximum enjoyment of life and vitality, in all its forms, with particular emphasis on fertility.

Language:

There are some thirty-four distinct languages and fourteen other non-indigenous tongues in use in Ghana. But the basic division is between Akan (especially the Twi dialect which is rapidly becoming the most widespread lingue franca in the country), and the other language groups.

English is the most widely spoken European language and is the official language of the country. It is the language of government, of the school system from the middle and secondary levels up, and is the predominant language of the government-owned Ghana Broadcasting Corporation.

Cultural Aspects:

The values and attitudes of each major ethnic group - Akan, Ga, Ewe, and Northern - have survived in contemporary Ghana with greater vitality than the institutions (i.e., chiefs and traditional states) they once served. The "Ghanaean experience" is readily adopted by the individual because children have meaningful contact with the national political system and modern agents of socialization quite early in life. Thus the individual retains the traditional with the modern easily.

Traditional culture is most visible in the acceptance and practise of spirit worship, ancestor veneration, and the concept of the extended family. In addition, Ghana shares a common cultural feature with most West African societies: the enjoyment of living with a special emphasis on fertility and sexual freedom. Marriage was considered for the purposes of procreation and the continuation of the family; and premarital chastity was not, and is not, important to many ethnic groups. Thus polygamy is still practised in most Ghanaean societies although monogomy is fast becoming the conjugal norm.

Other cultural differences exhibited by Ghana's "plural society" are seen in their regional lifestyles. In the south, a nucleared settlement pattern is common. The houses are rectangular and built of solid swish walls and bricks or concrete blocks, and have galvanized iron sheets or tiles for roofing. By contrast, in the northern savanna area, the settlement pattern consists of a compound of several families. The compounds are scattered over the region. Most houses are round and built of mud, with thatched roofs. They are mostly farmers and as such, great social emphasis and status is placed on the number of cattle one owns.

POLITICS

Government:

After eight years of another military rule, Ghana was for two years back to constitutional rule. The constitution of the Third Republic of Ghana, unlike previous constitutions which were based on the British system, was modelled along the constitution of the United States of America. The executive authority is vested in the president.

A presidential candidate must be at least forty years of age and a citizen of Ghana by birth. Such a candidate must not owe allegiance to any other country. He must be nominated for election as president by a document signed by him and at least two qualified resident voters of each district council.

The election of the president is by universal adult suffrage. A presidential candidate who receives at least 51% of the total number of votes cast in a presidential election is deemed elected as president of the Republic of Ghana. In the event that no candidate obtains this required number of votes, a second election is held within twenty-one days after the previous election. Such an election is only for the two candidates who obtained the two highest numbers of votes. This was necessary during the election of the previous incumbent president, Dr. Hilla Limann. If it happens that three candidates obtain the two highest numbers then the constitution empowers the parliament of Ghana to, within one week after the presidential election, select two of such persons to be candidates. Once elected, a president holds office for a term of four years and is eligible to stand for a second term.

At the national level, the president is assisted by a vice-president, sixteen ministers and their deputies. Each of the nine regions is manned by a regional minister and deputy regional minister.

The president and parliament are counselled by the Council of State. Any former president or head-of-state is a member of the Council of State if he so desires. A former chief justice, or a former speaker of parliament, or a vice-chancellor of a recognized university of Ghana, can be appointed as a member of the Council of State. Other Ghanaeans of proven eminence and merit can also be appointed to serve on this council. Membership of the Council of State can only be terminated by the president on grounds of stated misbehaviour, and with prior approval of parliament.

LINE OF GHANAEAN LEADERS

	TITLE	DATES IN OFFICE
1. Dr. Kmame Nkrumah	President	1957/1966
2. Gen. Joseph Ankrah	Chairman of NLC*	1966/1969
3. Gen. A.A. Afrifa	Chairman of NLC*	1969
4. Dr. Kofi Busia	Prime Minister	1969/1972
5. Ignatius K. Acheampong	Chairman of NRC**/SMC***	1972/1978
6. Gen. Fred Akuffo	Chairman of SMC***	1978/1979
7. Flt. Lt. J.J. Rawlings	Chairman of AFRC****	1979
8. Dr. Hilla Limann	President	1979/1981
9. Flt. Lt. Jerry J. Rawlings	Chairman of AFRC****	(Dec.)1981

NLC*	National Liberation Council
NRC**	National Redemption Council
SMC***	Supreme Military Council
AFRC****	Armed Force Revolutionary Council

Political Parties:

Following the Acheampong coup of 1972, all political parties were banned. This ban was lifted in 1979. As expected, there was a rush to form political parties. Out of the original nineteen parties only seven contested the presidential and parliamentary elections. Some merged and others were chopped by the electoral commission because they did not sufficiently represent national interests. The People's National Party (PNP) emerged victorious in these elections with seventy-one out of the one hundred and forty seats.

These seven political parties and their leaders which contested the elections were:

1. People's National Party (PNP)	Dr. Hilla Limann
2. People's Freedom Party (PFP)	Mr. Victor Owusu
3. United National Convention (UNC)	Mr. William Ofori-Atta
4. Action Congress Party (ACP)	Col. F.G. Bernasko
5. Social Democratic Front (SDF)	Alhaji Ibrahim Mahama
6. Third Force Party (TFP)	Dr. John Bilson
7. Vanguard Party (VP)	Kwasi Amoako Atta

INTERNATIONAL RELATIONS

Foreign Affairs:

Since coming to power the NRC government of Ghana had adopted a policy of non-alignment in foreign affairs. The present government's policy direction, however, contrasts with that of the two former governments in three aspects. First, Ghana has re-established relations with the Soviet Union and the People's Republic of China, which had noticeably cooled under the Western-oriented NLC and Busia regimes. Second, Ghana has done much to improve its relations with its neighboring African states which had been neglected by preceeding governments. And third, Ghana has revived the Nkrumah policy of supporting African nationalism and solidarity, and actively supports the revolutionary forces armed against the white regimes of South Africa.

Ghana is a member of the Commonwealth, the United Nations, and the Organization of African Unity. In addition, it is represented in a number of United Nations agencies - U.N.D.P., F.A.O., W.H.O., and the World Bank. There are over forty diplomatic and trade missions in Ghana. Canada has a High Commission with both diplomatic and aide representatives established in the capital, Accra.

Canada and the Commonwealth Africa:

When the United Nations was formed in 1945, there were only four countries in the entire African continent that qualified for membership as sovereign entities - Egypt, Ethiopia, Liberia, and South Africa. Nevertheless the continent was astir with a new urge to free itself from colonial rule and within the next decade a sequence of events propelled a number of African countries towards self-government. With the achievement of independence by Ghana in 1957, the era of decolonization began. Today, virtually all of Africa consists of sovereign states, which account for almost a third of the membership of the United Nations.

Canadian contacts with Africa go as far back as the nineteenth century. Canadian missionaries, geologists, teachers, and explorers, rendered important contributions to the social and economic development of Africa. However, leaving South Africa aside, it was only in the mid-1950s that Canada began establishing direct relations with African countries.

In the late 1950s Canada made limited external aid available to Commonwealth African countries, but it was not until the Commonwealth Prime Ministers' Conference in 1960 that a formal program of aid for these countries began. Canada, in partnership with Britain, Australia and New Zealand, established a special Commonwealth assistance plan under which it agreed to provide assistance on a continual basis to dependent as well as independent Commonwealth countries.

Terms of Financial Assistance:

Canada's assistance to Commonwealth Africa is transferred through both loans and grants. These transfers are made in ways that are intended to be as flexible and efficient as possible.

There are two types of loans: those with 0% interest, ten years' grace before the first payment, and fifty years' duration; and those with 3% interest, seven years' grace before the first payment, and thirty years' duration.

Under program grants, the recipient country allocates the CIDA funds to programs or projects which support national development plans and is responsible for their administration. This reduces the administrative burden of CIDA.

ECONOMY

General Overview:

Ghana's economy is primarily based on its agricultural sector. Approximately 92% of the labor force is employed by agriculture; 4% by fishing; and 3% by mining and quarrying. In contrast, only 8.6% of the working population is engaged in secondary occupations.

The Ghanaean economy displays many of the classic characteristics of a colonial economy. That is, the exportation of unprocessed raw materials and the importation of manufactured capital and consumer goods. Cocoa is the principal cash crop of importance. Responsible for about 75% of Ghana's foreign exchange earnings, it is unfortunately subject to extreme price fluctuations on the world market. In addition to cocoa, fishing, forestry and mining help to prop up Ghana's sagging economy.

The Ghanaean government has been running a deficit budget since the mid-1960s. At the time of Acheompong's takeover, external debts totalled 866,000,000 cedi ($1.00 U.S. equals 2.75 cedis).

When the NRC came to power in 1972, they immediately initiated major economic reforms to counter the country's huge foreign debts and food shortages. They revalued the cedi by 40% in an attempt to nullify Busia's devaluation and reduce strains on both domestic and external debt. They reversed Busia's liberal import policy, increased duties on all luxury items, and recently introduced import licenses to further restrict the volume of imports. They re-introduced an export bonus scheme as an incentive to exporters of non-traditional export items in order to reduce the country's dependency on cocoa, and in this regard duties on timber and gold were revised to improve their export position. Capital expenditures by government were cut.

The NRC has accomplished much in the way of stabilizing the economic conditions that threatened Ghana with almost total collapse in the early 1970s. Surplus budgets on the current account were even achieved in 1973 and 1974, however, inflation, higher energy costs, and a serious drop in cocoa price, have again created a serious balance of payments problems.

Development:

The major development problems in Ghana are easily identified - an agrarian nation dependent on a single crop, unable to feed itself because of the prevalence of shifting cultivation and subsistence farming; coupled with a lack of indigenous energy sources, a lack of capital, and an inadequate transportation/communication infrastructure. These are aggravated by the rapidly growing young population which, with increasing education, is moving into urban areas and, therefore, is less tied to the traditional economic system.

Ghana's most ambitious development project to date has been the Volta River Project. This involved the damming of the Volta river at Akosombo in the Akwapim-Togo ranges. The Volta River Authority now provides hydro-electric power for Ghana's expanding grid system, and an aluminum smelter at Tema on the coast; and exports power to Togo and Benin. The project has also created a huge lake 200 miles long covering some 3,275 square miles of the dry Voltaian Basin. Lake Volta has great potential for irrigation and a fishing industry, and is a valuable waterway uniting the north with the south.

In 1974 the government announced guidelines for a five-year development plan known as Operation Five Years (OFY) The basic aims were:

1) to increase export earnings;
2) to promote the greatest possible link between agriculture and industry;
3) and to use low capital input methods and concentrate on labor-intensive projects.

This policy and the general development programs of the NRC have two major thrusts - national self-reliance and state control over the main economic sectors. The first is best seen in the government's design to make the country self-sufficient in food production. In the first phase massive government funds have been invested in agriculture whereby specific crops were selected for intensive cultivation in specific areas. The initial concentration was on such staple items as cassava, maize, rice, plantains, yams, groundnuts, and vegetables. In addition, farmers were encouraged to increase output beyond their own needs, and more people were being encouraged to start food farming.

The second phase of OFY has now begun, with efforts aimed at consolidating gains (agricultural output in food production increased substantially in the mid-1970s, especially maize and rice), and intensifying the production of such industrial raw materials as sugar, cotton, tobacco, mangoes, pineapples, ginger, etc., in order to establish agro-based industries. In addition, the OFY program also included the expansion of livestock production with a new emphasis on dairy cattle, and the introduction of mechanization and irrigation in the north to turn it into the country's "granary".

The second major thrust of the NRC's development program is the eventual establishment of Ghanaean control over its economy. Although the government encourages direct foreign investment, and welcomes foreign companies, there are now strict provisions to establish a mixed economy and to get the maximum development benefits.

Cocoa, mineral and timber production, and exports, are now regulated by government marketing boards. Public utility projects and infrastructure projects are reserved exclusively for state participation, as well as 50% of every company involved in commercial television and broadcasting. In each enterprise having an employment capacity of 500,00 people or an annual turnover of at least 1,000,000 cedis, and in all timber and mining enterprises, the state requires for itself a minimum equity participation of 55%. In oil and aluminum enterprises, the government requires only 30% participation due to the sophisticated technologies and high research costs experienced by firms in these industries.

Agriculture:

Ghana is an agrarian nation with two out of three Ghanaeans employed on the land. Because of the physiography of the land, there are three major agricultural zones: the dissected forest plateau of the south and southwest; the dry southeast coastal plains; and the northern savannas. With the exception of the cocoa plantations, most farm holdings are, on average, only 2.7 acres. The practise of a shifting type of farming, combined with the small size of the farms, has not been fruitful in solving Ghana's food supply problem. At the beginning of the 1970s, food and animal imports accounted for roughly 16% of the country's import bill.

The main export crops are cocoa, coffee and palm oil, and cash crops of yams, plaintains, cocoyams, and cassava.

The main cereal crop is maize and, more recently, rice and a wide assortment of vegetables have been grown. Throughout the forest zone the tsetse fly prevents the raising of livestock although all villages have sheep, goats and fowl.

The government has initiated a major economic development program aimed at mobilizing capital, labor and resources in order to increase food production.

This was achieved in maize and rice production by the mid-1970s.

Mining and Timber:

The pre-Cambrian rock of the dissected forest plateau in the south and southwest contains great mineral wealth in gold, diamonds, manganese, and bauxite. Gold production accounts for just under half the gross value of all mineral production. It was first mined in the alluvial terraces of the plateau lowlands, but now the most productive gold fields are around Obusasi, Konongo and Bibiani, located further north in the uplands of the plateau.

The second most important mineral is diamond (industrial), found principally in the eastern region, and to a lesser extent, in the western region. Near the Bonsa valley is a very rich deposit of manganese. Both diamonds and manganese are mined by the open-cast method.

Bauxite is perhaps Ghana's most abundant mineral resource but is the least exploited.

This is likely to change soon as the government is pressing the American-owned VALCO smelter at Tema to switch to local crude bauxite, and there are now plans for the construction of another government-owned smelter. In addition, during 1973, the government acquired equity participation of up to 55% in all foreign mineral and timber companies.

The timber industry in Ghana represents another important primary resource accounting for approximately 10% of the total value of exports during the early 1970s. The forest zone is rich in such tree species as wawa or obecke, sapele, mahogany, utile, and makore. 90% of Ghana's timber production comes from the less settled, peripheral western reaches of the forest zone in the western region and western Brong Ahafo and Ashanti.

Energy:

One of the major development problems facing Ghana is its lack of indigenous energy sources. Its traditional energy source has been wood. Small quantities of oil have been found at Keta and in the Nzima area. This is why the Volta River Project, originally completed in 1966, is so important to the country.

The power plant at Akosombo has recently been enlarged from four units of 512 megawatts' capacity, to six units of 768 megawatts. The dam and power station are linked directly with the VALCO smelter at Tema.

About 50 to 70% of the power produced is used by this smelter and the rest is fed into the expanding Ghanaean electrical grid system, or exported for sale to Togo and Benin via a recently constructed high-voltage transmission line.

In addition, an oil refinery has been constructed at Tema which uses imported crude oil from Nigeria, Libya and the Soviet Union.

Industry:

Within Ghana there are basically two types of industries: many widely-spread, small establishments; and a very few, medium-sized and large concerns. Although there exists a large number of "village industries" engaged in handicrafts, pottery, building materials, the manufacture of clothing from imported fabrics, the baking of bread, and the brewing of low alcoholic-level pito, Ghana's most important industries (in terms of the number of establishments and employment) are food processing and the manufacture of wood furniture.

Modern large-scale industrial concerns in chemicals, textiles, engineering, and metallurgy, have only appeared in the last fifteen years. They are concentrated in the four coastal cities of Sekondi, Takoradi, Accra and Tema, and most are associated with some form of government participation. The Tema area has shown the greatest growth in industrial activity in recent years because of its fine harbor facilities, and the provision of electrical power from the Akosombo plant which is forty miles north. As part of the OFY (Operation Five Years) program, the NRC government is encouraged to develop agro-based industries which will use such crops as cotton, tobacco, ginger, oil palm, etc., as raw materials.

At the same time attempts were made to increase the competitiveness of domestic manufacturers so that Ghana might better take advantage of export potentials opened to her following the signing of of the ACT/EEC and ECOWAS Agreements.

Trade:

Internal trade in Ghana is basically a two-way trafficking of food-stuff. Salt and livestock go from the north and southeast coasts to the cities; and manufactured or imported goods move from the coastal cities inland.

Ghana's external trade, however, has been a source of major concern for over a decade. The large national debt, combined with the drop in the cocoa price, and a generally unstable economic situation, have created debts and seriously threatened development efforts. Consequently, the NRC government abbrogated some debts and signed new repayment schemes with the creditor countries.

During the early 1970s, some 65 to 75% of Ghana's foreign exchange earnings were from cocoa exports. Mineral and timber exports accounted for the balance of approximately 20 and 10% respectively. At the same time approximately 60% of Ghana's imports were manufactured goods, while food and livestock imports accounted for another 18%.

Ghana's main trading partners reflect this pattern, being primarily with the industrial countries of Europe, especially Britain. Of the Commonwealth countries, Ghana trades regularly with Canada, Australia, Hong Kong, India, and Pakistan. Canada's trade with Ghana has been in food, cocoa, timber, and minerals.

Tourism:

Ghana possesses many tourist attractions - endless white beaches, the giant man-made Lake Volta, the hill and forest scenery of the south and southwest, the Mole Game Reserve in the north, and many historical-cultural attractions. These, however, were not fully exploited in the past.

The government launched a major program for the development and promotion of tourism. It is estimated that 108,000,000 cedis was spent on infrastructural development and 55,000 to 350,00 people were anticipated to visit Ghana in the next few years. The program was financed by governmental and private sources as well as by direct government allocations. However, the drop in cocoa value on the world market, aided by cocoa-smuggling operations, brought about a rapid devaluation of the cedi. It is at this time impractical for tourists to travel in Ghana, both on account of the currency and the road surface conditions. The world-class resthouses which were built now lie derelict and overgrown.

Educational System:

The new education system consists of four basic stages - kindergarten/nursery, primary and middle school, secondary and university.

a. Kindergarten is of eighteen-to-twenty-four months' duration for the age group of four to six years.

b. Primary and middle school, known as Basic First Cycle Education, consists of six years of primary education followed by three years of junior secondary education. This is basic, free, and compulsory for all. Depending on the teacher availability, languages taught in addition to the local dialect are Arabic, and in the more populated areas, French, and the compulsory English.

c. Secondary or Second Cycle Education, consists of two divisions. Depending on their academic standing, students may elect to attend "terminal" or "formal" education courses. Terminal courses include the G.C.E. 'O' Level Certificate which covers technical or commercial courses. Formal courses include the G.C.E. 'A' Level Certificate which is a teacher-training or polytechnic course.

d. University education includes courses that lead to a degree.

The Ministry of Education and Culture is responsible for the administration of the national system. However, several regional boards and the Ghana Teaching Service, established in 1974, cooperate with the Ministry and the National Manpower Board in coordinating the new policies and strategies.

Under a new structure, religious bodies have been relieved of their school management functions. In view of their contributions in the past, however, the government has provided for their continuing input with the establishment of the Bureau of Religious Interests at the National Headquarters of Service. In addition, religious bodies are represented on the Teaching Service Council, the Regional and District Advisory Committees of the

Council, and the School Management Committees.

HEALTH:

The most commonly reported illnesses in Ghana are malaria, gastrointestinal diseases, dysentery, parasetic diseases, yaws, pneumonia, and tuberculosis. Leprosy, sleeping sickness (carried by the tsetse fly), and venereal diseases are also present.

By the late 1960s, it was estimated that only 25% of the population, largely among the educated classes in urban areas where medical facilities tend to be located, had accepted modern medicine. Approximately three-quarters of the population still relies, to some extent, on native doctors and ancient remedies. There are two principle reasons for this: the lack of accessibility to modern medical facilities and the traditional beliefs that illness and death are caused by supernatural forces.

Medical facilities in Ghana are provided by the central government, local governments, Christian missions, and private organizations, i.e., companies.

All of these are under the jurisdiction of the Ministry of Health. Each region has a chief medical officer in charge of the administration and control of health programs and affairs located there. In addition, the country is divided into twenty-four health districts, each under a superintendent who is assisted by a number of health inspectors who in turn are in charge of administering the public health standards.

CHAPTER III

PHILOSOPHY OF THE DEVELOPMENT OF A CLEAN WATER SUPPLY IN PHASE I OF THE CIDA PROJECT:

Physical and Climatic Features of the Area:

In Chapter II, a brief view of the national features of ghana was given to establish a background to the development of clean water supplies to the Upper Region of Ghana, more especially the Bolgatanga, Gowri and Bawku site areas.

The Upper Region of Ghana is one of nine administrative regions within the country. It is located along the country's northern boundary with the Upper Volta Republic, and covers an area of approximately 11,000 square miles located between latitudes of 9°40' north, 11°15' north, and between longitudes 3°55' west, and 0°01' east. For the purpose of the urban and rural water-supply program, that portion of the Northern Region, lying north of 10°30' north-latitude, is included within the area covered by the rural water-supply project and this study.

The areas are contained in part of the drainage basin of the Volta River systems, characterised by low, rolling relief ranging between 500 and 800 feet above mean sea level. The climate is tropical. Temperatures range between an average maximum of 92 degrees Farenheit and and average minimum of 72 degrees Farenheit. Annual rainfall varies from about 35 inches in the western section of the region, to approximately 45 inches in the eastern section. Rainfall is concentrated in a four-month period occurring between May and October, during which time nearly all of the total annual rainfall is experienced. Table I, issued by the Bolgatanga Regional Meteorology Office, shows readings for the year of 1980.

A CIDA report on the area denotes that the region is underlaid by crystalline rocks, predominently granites, phyllites, schists, grey wackes, and metamorphosed volcanic and pyroclastic rocks. Residual surface soils, formed through weathering, consist of sandy-clay mixtures of very low permeability. Underlying these sandy-clay soils is a zone of partially decomposed rock having a high permeability. These materials average about 75 feet in depth, although considerable variations occur. The bedrock is generally impermeable except in sheer and fault zones.

The report goes on to say that nearly all developed water supplies throughout the region are based on exploitation of ground water which is found in the decomposed rock, and in sheer and fault zones. Ground water typically occurs in limited quantities which are, however, generally sufficient for most small urban schemes, and for rural supplies.

METEOROLOGICAL STATIONS IN GHANA UPPER REGION

NUMBER OF STATIONS:

Synoptic - 2
Agro/Climo - 9
Rainfall - 20

TABLE I

1980	MAX MEAN °C	MIN MEAN °C	HUMIDITY	TOTAL RAINFALL IN MM
January	36.5	21.2	34	1.0
February	37.5	23.4	24	0.0
March	39.2	25.7	32	1.3
April	38.8	27.0	57	22.9
May	35.7	25.3	76	138.8
June	32.6	23.7	88	119.0
July	31.2	23.3	89	81.0
August	29.7	22.5	92	212.9
September	31.8	22.4	92	94.8
October	33.9	23.0	91	104.6
November	35.2	22.1	72	0.0
December	33.4	18.9	30	0.0

Information Received from:

Samuel Boachie-Yiadom
Senior Technical Officer
(METEO)

TABLE 2

UPPER REGION - Locations with pipe-borne water supply schemes

Location	Population	Location	Population
Wa	21,374	Bawiabia (Central Navrongo)	1,224
Dokpon	311	Balobia (Central Navrongo)	249
State Farm Co-op	103	Navrongo (Central)	1,127
Bankpi	217	Namolo Balobia	366
Gogor	159	Namolo Pungo (Central Navrongo)	214
Touour	80	Namolo (Central Navrongo)	959
Tououri	99	Naogsenia (Central Navrongo)	290
Zinkaa 1	70	Wuru	601
Jirapa	3,520	Nogsenia	228
Lawra	2,790	Apiabia (Central Navrongo)	3,047
Tom	524	Kakungu	294
Nandom Hospital	110	Page Kakungu	858
Kusiele	353	Kakungu	1,313
Nandom	3,236	Poloyo	484
Tumu	4,366	Yarigabisi	19
Abiliyeri	155	Agungabisi Yarigabisi	398
Sandema (Central Sandema)	205	Awanbisi Yarigabisi	162
Abiliyeri (Central Sandema)	208	Aganabisi (Zuarungu)	270
Chuchuliga Anaabila	25	Moshie Zongo	247
Abiliyeri	1,176	Zuarungu Agricultural Station	193
Navrongo Secondary School	775	Bolgatanga	18,896
Navrongo Farm Institute	107	Binaba Natinga	471
Bundunia	63	Binaba Natinga	434
Atungbise	157	Zebilla Nanginga	1,063
Asinabise	72	Nayeko Agricultural Station	102
Navrongo Farm Institute	22	Bawku	20,567
			94,293

TABLE 3

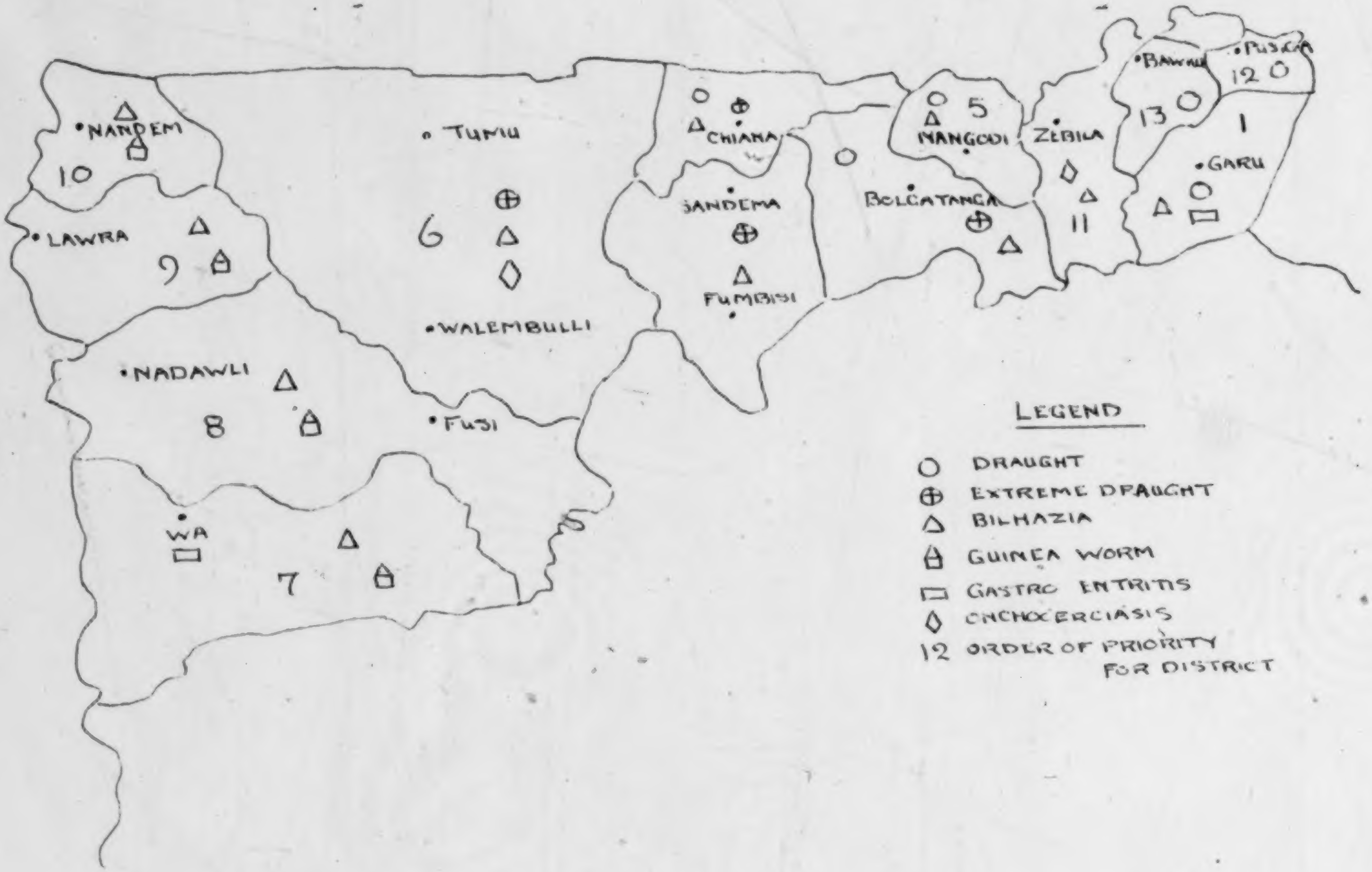
UPPER REGION - Population 1970

Sub-region	No. of Localities	Population
Wa	280	90,049
Nadawli-Funsi	247	63,860
Lawra-Jirapa	238	75,203
Lambusie-Nandom	133	48,311
Tamu	120	42,442
Sandema	194	51,782
Navrongo	150	48,086
Chiana-Paga	133	50,920
Bolgatanga-Tongo	206	95,010
Bongo-Nabdam	247	77,192
Kusanaba-Zebilla	138	44,714
Tempane-Garu	125	61,716
Bawku	117	74,851
Pusiga-Pulimakum	83	38,587
	2411	862,323

All water supply and sewage disposal development and maintenance throughout Ghana is the responsibility of the Ghana Water and Sewage Corporation (GWSC), a state-owned corporation inaugurated in September, 1966, from Act of Parliament 310 of 1965. The corporation continues the work initiated at the time of British rule, when shortly before the outbreak of the First World War (1914 to 1918), public water services previously restricted to Accra were extended along the coast to Cape Coast and at Kumasi, the capital of the Ashanti in the northwest.

Rural Water Supplies Intended for the Upper Region:

By far the majority of the population of the Upper Region is located on individual family-compound farms and in small communites with populations of a few hundred, to approximately 1,500. The distribution of population is such that pipe-borne water supply facilities are not appropriate to serve the major portion of the population. The bore-hole wells were therefore scheduled to be equipped with hand-operated pumps. Each hand pump was expected to serve a population of 300 to 350 persons, the philosophy being, at this stage, to leave scattered compounds having a population of less than 200 persons to rely upon their traditional water source.



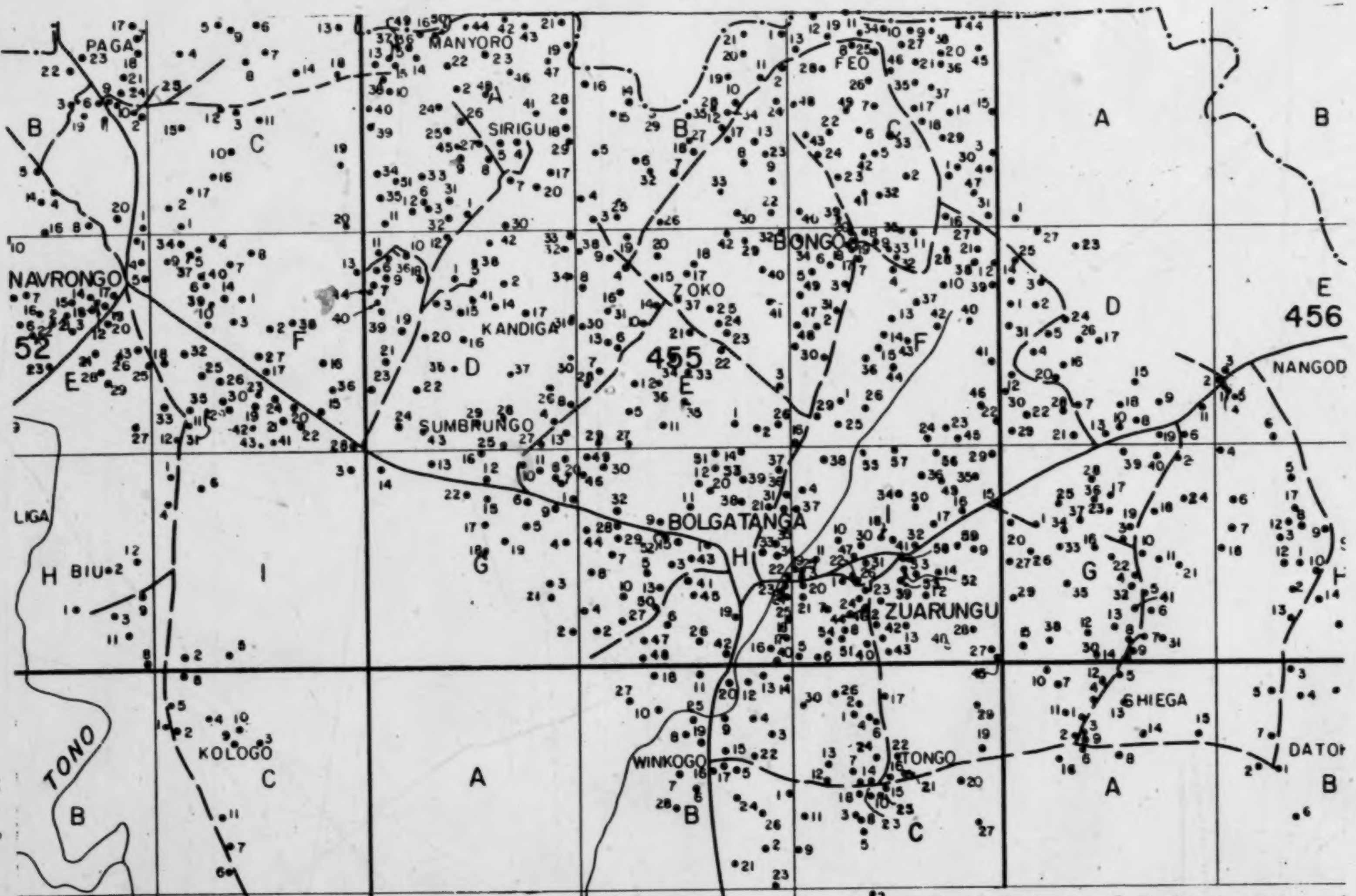
NANDEM
10
LAWRA
9
TUMU
6
WALEMBULLI
NADAWLI
8
FUSI
WA
7
CHIANA
SANDEMA
FUMBISI
BOLGATANGA
NANGODI
5
ZEBILA
11
BAWKU
13
PUSIGA
12
GARU
1
LEGEND
○ DRAUGHT
⊕ EXTREME DRAUGHT
△ BILHAZIA
GUINEA WORM
▭ GASTRO ENTRITIS
◊ ONCHOCERCIASIS
12 ORDER OF PRIORITY FOR DISTRICT

MAP I.

GHANA UPPER REGION

AREAS OF WATER BORNE DISEASES & DRAUGHT

Map 2


PAGA
NAVRONGO
52
MANYORO
SIRIGU
KANDIGA
SUMBRUNGO
ZOKO
455
FEO
BONGO
BOLGATANGA
ZUARUNGU
NANGOD
456
SHIEGA
DATO
TONGO
WINKOGO
KOLOGO
BIU
LIGA
TONO

Hand Pumps of Bolgatanga

Rural Water Supplies Intended for the Upper Region:
A provision was made by GWSC that their intended policy was for all towns with a population of over 1,500 to have pipe-borne water-supply systems in the Upper Region, a subject which will be discussed in the next chapter.

For the majority of this rural population, therefore, the source of supply, prior to the provision of hand pumps, was from rivers, lakes, streams, small dams, small dugouts, and hand-dug drifted wells. All of these were centers of social interaction and therefore sources of amoebic dysentry, polio (poliomyelitis), roundworm (ascariasis), trachoma, bilharzia (schistosmiasis), Guinea worm, malaria, river blindness (onchocerciasis), and hookworm. Map 1 shows areas of water-borne diseases and drought, and the order of priority set to alleviate the problems with clean water supply.

The 1975 population of the Upper Region was approximately 875,000 which, based on the GWSC philosophy of one bore-hole for each 300 of population serving this number with hand pump bore-holes, would require a total of slightly over 2,900 installations. However, since the actual ground-water availability of the Upper Region was not known at the time of this CIDA study, provision for 2,500 hand pump installations was recommended at that stage.[2]

The CIDA program for rural clean-water supply in the Upper Region of Ghana may be summarized hereunder:

a. The drilling of some 2,300 shallow boreholes, with a recommendation for a further 200, for a total of 2,500.

b. The supply and installation of an equivalent number of hand pumps.

c. Location and cleaning of existing wells in communities with a population of less than 500 people (an involvement of 130 communities covering 160 wells), including the supply and installation of hand pumps.

d. The supply and installation of replacement hand pumps for existing wells, where the existing hand pumps were inoperative and beyond economical repair; an involvement of 55 units.

e. The construction of a base maintenance workshop at Bolgatanga, and of district workshops at Wa, Bawki and Tumu; and supply of equipment for these 4 district stations, including 5 mobile maintenance units.

The consultant, appointed to oversee the drilling of bore-holes and the construction of pipe-borne clean water supplies, was required to provide the following services - as quoted from the CIDA-issued specification:

a. Planning, designing, specifying and supervising construction of reinforcements to existing water supply systems at Wa, Bawku and Bolgatanga.

b. Training of Corporation (GWSC) staff in the operation and maintenance of these systems.

c. Hydrogeological and geophysical investigations to locate ground water resources throughout the Upper Region.

d. Operational and training assistance in water well-drilling for rural water supplies throughout the Upper Region.

e. Establishing a maintenance program and training of Corporation staff in well installation and maintenance.

f. Specifying, purchasing, inspecting, and expediting delivery from Canadian factory-to-site, where equipment and materials procured off-shore through Canadian loan funds will be used. In this respect, the Consultant will act as the agent of the Ghana Water and Sewage Corporation. In so doing, the Consultant shall follow procedures for procurement as specified in the loan agreement.

g. Assisting in the selection of local construction contractors, sub-contractors and suppliers.

h. Advise and assist in the design and supervision of construction of workshops, warehousing, and other facilites required to support the program and the continuing operations of the GWSC in the Upper Region.

Without limiting the generality of the foregoing, the Consultant's services shall include the performance of all professional and technical studies, field investigations, supervisory services, training activities, and related work needed to achieve the purposes of the program as set forth hereinafter.

Technical and Sociological Appropriateness of Rural Water Supplies: The Absence of Grass-root Studies and the Consequences

As mentioned earlier in this chapter, before the provision by CIDA to GWSC of the 2,500 hand-operated water pumps, most water supplies available were from surface water sources such as rivers, streams, lakes, small dugouts, hand-dug drift wells, surface ponds, or whatever constituted a temporary but convenient source of water. Surface water sources are usually contaminated, more especially small bodies of water such as ponds, dugouts and drift wells, where animals use the same water source as the people. There is in the area of study, as in other developing areas, an ingrained disposition among the villagers to use these traditional water sources, and a disinclination towards maintaining cleanliness at the site. Water acquisition is for most village women a matter of the most expedient convenience rather than a matter of cleanliness.

There are hundreds of shallow hand-dug wells throughout the study area which continue to be utilized in disregard for the presence of the hand pumps. Because of the use of open-topped jars and other receptacles for drawing water, they are invariably polluted. Large-diameter, machine-dug wells show little improvement since, though the well may be dug deeper, providing greater reliability during Harmattan, the water quality remains poor. If wells are dug too deep, high saline-content water may be encountered. This will discourage the use of the well. Flavor rather than cleanliness is the criterion for family drinking water. The only merit which may be placed on hand or machine-dug wells is their relative convenience during most of the year, and low-cost maintenance. Open-topped wells do not, however, constitute a reliable and potable water supply free from health hazards. A permanently secured and sealed top with a hand pump somewhat improves health risk.[3]

In rural areas, 100-millimeter bore-holes, drilled and cased to a depth of 30 to 50 meters, may be considered most satisfactory to provide domestic water requirements of rural areas in the Upper Region and elsewhere. Properly constructed bore-holes will provide a long-term, adequate source of water with no maintenance required for the bore-hole itself.[4]

Such ground water sources are normally used without treatment to provide a year-round supply which is both reliable and potable.

In the light of experience discussed in the next chapter, bore-hole water supply methods constitute the only practical means of tapping ground water sources in the study area, and in developing countries in general. In a region where rural electrification is non-existent or slow to develop, or where diesel fuel is expensive and in short or unreliable supply, hand pumps become the only acceptable alternative if the physical and mental health of the population is to be considered.

Here lies the disadvantage of bore-holes since, though hand pumps are becoming more reliable and appropriately designed, the ideal pump has not yet been manufactured. Therefore, the maintenance aspect of hand pumps, or the lack of it, constitutes the most serious constraint to providing reliable water supplies by way of a bore-hole construction program as envisaged by CIDA.

To the credit of CIDA, the specification already discussed required:-

> The Consultant shall investigate the ground water resources in the area of each of these centers, and shall perform pumping tests and direct the recording of other data, so as to provide a reliable estimate of the safe and total yield of existing well fields.

The successful consultant, W.L. Wardrop and Associates Ltd., Winnipeg, recognized that ground water at the amounts required for relatively low-volume hand pump supply, is more readily available than local records or opinions would first indicate. In their hydrogeological and geophysical investigations, therefore, water was found where for many years villagers were told that no water existed. The sociological benefits derived from the technical experience and ability of the consultant served to gain considerable support for the project from villages, not only in their cooperation in the exploratory and discovery stage, but also in the acceptance of the water, whatever its taste, and in the protection of the long-hidden water source. A significant community-development feeling of possession or ownership, rather than mere utility, was placed upon the hand pumps located within their socially designated area of domicile, as will be discussed in Chapter V.

Due to cost, difficulty of organization, and the resulting constraints of time, most aid and donor-sponsored ground water-supply surveys are patterned on a macro-supply level, such as would be the case where pipe-borne water supplies for concentrated communities of over 1,500 would be required.

In the past, little or no consideration has been given to grass-roots studies based on the provision of small-diameter, low-yield bore-holes, ideally suitable for rural populations using hand pumps. It is, therefore, frequently warranted that some additional testing be completed before eliminating an area from ground water-supply considerations.

The Problems of Appropriate Hand Pump Selection:

As hand pumps were installed in the areas shown on Map 3 a five-year continuous pump test-program was instituted by the Consultant during which time more than 100 pumps were evaluated, involving 17 different manufacturers from 11 countries, and including a wide variety of models. During the tests, the pumps under surveillance were visited every 15 days and thoroughly inspected twice each year. Breakdowns were examined and recorded; three detailed reports were issued to CIDA on the findings. The object of the Wardrop tests was not only to establish the durability on Upper Region site of pump units currently on the market, but also to encourage manufacturers to replace components found to be weak under communal behavior and climatic conditions existing at the majority of installations. The hand pump purchases for the project were therefore based on a combination of the appropriateness of the pump design and durability; and on the willingness of the manufacturer to take the opportunity of free field-testing in rectifying weak aspects of the product.[5]

Some of the better known pumps utilized in Canada by both Federal and Provincial parks departments failed early in the tests; others failed during the test period. Some were at that time being currently recommended by other donor nations as preferred models.[6] All of the so-called

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"low-replacement-cost" pumps, and those intended for "local manufacture", failed to sustain the manufacturer's claims and were removed from the program to avoid detrimental effects on the clean water program.

The most important lessons learned from the CIDA/Wardrop tests in the Upper Region of Ghana may be listed as -

1) Selection of hand pumps for rural clean water-supplies should never be based on laboratory tests alone, regardless of the test duration. At best, laboratory testing is only a preliminary method to select various models for further field testing under site socio-technical conditions.

2) Field test results based on pumps in rural water-supply service, and which were conducted over a continuous period of less than two years' duration, should be considered as inconclusive. The typical six-month test is considered worthless since most hand pumps will survive for six months, several will function for a year, but the relative longevity and trouble-free operation does not become truly evident until after two years of continuous field operation. Nothing less than a two-to-three-year period of trouble-free operation should be

considered acceptable for a hand pump selected for conditions similar to those existing in the Upper Region.

3) No pump should be considered acceptable for such site conditions if it is not equipped with bearings at pivot points. Such refinements outlast any other arrangement and constitute a low-cost investment in return for a much improved reliability factor.

4) Dual leather piston cups operating in brass cylinders may be expected to survive two-to-three years without replacement under typical village service. However, the helical rotor-type configuration can be expected to survive for a longer period without being withdrawn for component replacement or repair. This life-factor will of course vary, depending on the presence of sharp sand, which can reduce the life of conventional pistons by 800%.

5) The most appropriate pumps for the region are currently the most expensive on the market.

6) Re-inhibiting of hand pumps in the field, immediately before being installed, is essential. Units arriving from the manufacturer or his agent are not ready for field operation.

Factors to be considered in selecting hand pumps for self-help projects:

To expand the 2,500-pump-installation project, the Ghana Water and Sewage Corporage (GWSC) has considered local development at the village level, with the Corporation providing mobile well-drilling equipment and crew, together with the supply of materials. Hand pumps would be manufactured at appropriately equipped centers in Ghana, and installation and maintenance would be the responsibility of a village 'water-pump and site-maintenance committee'. However, in the light of experience hitherto in the Upper Region, note must be made of certain criteria.

Considerable research and testing is currently in progress, the most notable being the UNDP World Bank Global Programme[7] Project for hand pump field tests. In some areas at this time, these low-cost pumps may be effectively used, particularly on shallow wells of less than 7 meters in depth. However, for deep-well installations in many areas, such hand pumps are not acceptable because of the unreliability of component manufacturer accuracy, and the doubtful nature of the indigenous manufacturing material. At best, pump parts could be shipped to centers in Ghana and similar nations for local assembly from a kit.

A substantial portion of villagers was found by CIDA cooperants and Wardrop personnel to be incapable at this time of maintaining their own pumps. Social activities in villages in the Upper Region and elswhere, do not equip the people with mechanical aptitudes: their skills are centered around such daily tasks and subsistence maintenance as clay wall-building, thatching of roofs and grain storage silos, and other rice straw and millet stalk artisanary. Villagers are rarely if ever involved in mechanical tasks. Those who have been employed in the towns on vehicle and machinery repairs are not about to lower their social status to take on water pump repairs.

With continued development in the towns, mechanical skills may be expected to reach outlying villages and compounds in no earlier than five-to-ten years. This subject is bound rigidly with community health levels which will be discussed further in Chapter IV.

SUMMARY

Due to the remote location of many of the hand pumps installed, the lack of either Canadian or Ghanaean personnel, the cutting back of CIDA aid expenditures, and the worsening economic situation in Ghana, many unsuitable hand pumps remain installed. Considerations for future well-boring by GWSC, therefore, lean towards self-help and low-cost installations. If savings are the objective, then the effort should be directed to bore-hole construction, not hand pumps. A pump will rarely cost more than three-to-five percent of the bore-hole construction into which it is installed, as judged from CIDA/Wardrop experience in the Upper Region.

At this time, certain medium-to-high priced pumps are well worth the expenditure because of the increased reliability they can provide. Until such time as a particular village is capable of adequately maintaining its hand pumps, it should not be encumbered with the frequent replacement of worn-out parts associated with present low-cost pump designs.

CHAPTER 3

FOOTNOTES

1. Ghana 1977 - an official handbook

   Pub: Ghana Information Services Department
   Printed by New Times Corporation, Accra

2. The initial plan and request to CIDA by GWSC was for 1200 bore-holes fitted with hand pumps. The CIDA-appointed consultant requested 2,500 to cover all rural areas, together with certain urban districts not supplied by pipe-borne supply systems.

3. Winches, utilizing a single bucket while being technically less likely to carry water-polluting elements since the water would be transferred on the well casing rim rather than placing the receptacle on the polluted ground, are much too slow for serving up to twelve women, and are dangerous if the loaded winch handle is released for any reason.

4. Domestic requirements for non-pipe-borne water supplies can, by World Bank estimate, and by Upper Region local survey, be considered as follows:

   5 liters minimum per day for cooking and drinking, but a further 25 to 45 liters per person to stay clean and healthy. A woman can carry by head portage approximately 15 liters, each liter weighing one kilogram kilogram. To provide water for cooking and drinking for the average family living in a compound, 40 liters are required, or say, 3 visits to the water source. If water is fetched to keep the family clean and healthy, then 200 liters are required, or say, 15 visits to the water source each day.

5. McGinnis, Lloyd R. Rural Water Supplies in Developing Countries
   Paper presented to the EIC, 96th Annual Congress, Vancouver, B.C. 1982 p.8

6. Favorable laboratory reports of test results continue to be issued to the media and to the governments of both donor and recipient nations even though 5 years of CIDA/Wardrop testing shows these same pumps to be unable to withstand field social behavior, physical and climatic conditions.

7. Arlosoroff, Saul, World Bank Presses on with Hand Pumps Testing Programme in Waterlines
Vol. 1, No. 3.
Technology Publications Ltd. January, 1983

UNDP/World Bank Rural Water Supply Project for the Testing and Technological Development of Hand Pumps GLO/79/010 (INT/81/026)
Interim Report A9940/2

Laboratory Tests on Hand-operated Water Pumps for Use in Developing Countries

World Bank
1818 H. Street
Washington, DC 20433
USA

CHAPTER IV

HEALTH IMPLICATIONS OF RURAL WATER SUPPLIES AND THE LACK OF SOCIAL SUPPORT SYSTEMS:

Medical experts repeatedly claim a clean water-supply can have the greatest effect on the health of rural populations than any other single factor. Although the potential benefits are there, a clean water-supply does not ensure improved health.

As Richard Feechem, of the Institute of Tropical Hygiene, London, asks, "What faith is it that makes us think that we can turn a poor, deprived, sick child into a poor, deprived, healthy child, simply by providing clean water?"

It would seem that CIDA officials, together with most governments and donor agencies, tend to assume that clean water must be a good thing; that even if just a few families benefit, that must be better than nothing.

Water-related Diseases in Ghana:

Among the water-related diseases in Ghana, malaria is the most serious and is on the increase, followed by dysentery and other gastro-intestinal diseases. Bilharzia (Schistosomiasis), the third most prevalent water-related disease, has been increasing nationally since the formation of the Volta lake.

Therefore, any failure or deficiency in the rural water-supply system described here must not indicate that such shortcomings are by any means wholly responsible for the continued failing health of villagers.

It must be understood that, from the combined sociological and medical viewpoints, the present constraints of health-care in the area under study may be listed as follows:

a) The treatment of acute-care takes so much of the time of existing clinic and hospital staff that prevention and health education are neglected.

b) Those medical health staff employed in the rural areas are inadequately trained for effective field treatment.

c) Inadequate funding is available to provide truly mobile treatment units needed for rural areas.

d) No storage facilities or transportation for food distribution programs, initiated by donor agencies, more especially those organized by the Catholic Relief Services from Bolgatanga.

e) Lack of drugs and vaccines, especially for measles in the dry season.

f) People regard medicine as magic and are sometimes prepared to deceive medical staff to receive it.

g) Traditional beliefs keep many away from hospitals and clinics.

h) Traditional healers sometimes prevent children from being treated at the clinic, sometimes resulting in the death of a child.

i) A Naba, or sub-chief, may deny, "for protective purposes", the departure from a village of a mother to travel alone to obtain clinic treatment for a sick child, more especially if it is female.

The increased occurrence of Sahelion drought and increasingly poor harvests in recent years, have produced an increasing number of chronic under-nutrition and malnutrition cases, with the concomitant problem of lowered resistance to infections of various types, together with increased mortality and morbidity rates of both children and adults in the area. Bolgatanga hospital administrators estimated that in the year ending September, 1978, the mortality rate for children was 50% for children under five years of age, mostly because of dehydration. This figure is now sharply reducing.

There is an increasing number of young mothers with inadequate breast milk, linked with the greater number of malnourished children, in addition to significant numbers of mothers dying at childbirth.

The two major types of malnutrition treated by medical health units in the area of study are:-

a) Morasmus

b) Kwashiorkor

Marasmus refers to a deficiency of all calories with symptoms which include dehydration and emaciation. Kwashiorkor, in contrast, involves severe protein deficiency. Children with Kwashiorkor display swollen legs, feet, abdomen, face, and eyelids; edema of the body; skin breakdown and dehydration.[1]

There are links between malnutritian and water-related diseases. Malnourished or undernourished children are more susceptible to gastro-enteritis and chronic diarrhea. Failure of breast milk may also lead to increased susceptibility, on the part of both mother and child, to diseases such as malaria. In severe drought periods, as are now frequently experienced, women must work even harder and breast milk failure is exacerbated.

Referring now to the water-related diseases, it may be useful, as a means to stress the importance of providing a truly clean water supply, to list the mechanisms of water-related disease transmission.

Feacham (1978) and others have indicated four primary mechanisms exist in the transmission of water-related diseases.

1) Water-borne mechanism: The disease is transmitted when the disease-causing organism, the pathogen, is in the water which is then consumed by a person or animal which may then become infected.

2) Water-washed mechanism: A water-washed disease is one whose incidence will fall following increases in the volume of water used for hygienic purposes, regardless of the quality of the water.

3) Water-based mechanism: In the case of a water-based disease, the pathogen spends part of its life cycle in an intermediate aquatic host. All such diseases are due to infection by parasitic worms.

4) Insect vector mechanism: Refers to water-related diseases which are spread by insects which either breed in water or bite near water.

TABLE 4 presents the foregoing classification of transmission and indicates the appropriate preventive strategies for each.

TABLE 4:

Transmission Mechanism	Preventive Strategy
Water-borne	- Improve water quality - Prevent casual use of other unimproved sources
Water-washed	- Improve water quality - Improve water accesibility - Improve hygene
Water-based	- Decrease need for water contact - Control snail populations - Improve quality
Water-related insect vector	- Improve surface water management - Destroy breeding sites of insects - Decrease need to visit breeding sites

Dr. Ted Jackson, of the Department of Adult Education, Ontario Institute for Studies in Education, Toronto, Ontario, Canada, reporting on behalf of CIDA, has pointed out that one problem with this classification system is that all fecal-oral diseases, that is to say, those transmitted by pathogen passing out of the excretion of an infected person, and subsequently being ingested, may be assigned to both water-borne and water-washed categories.

This does indeed lead to difficulty in data collection and interpretation of results in studies designed to assess the health benefits of improved water supply. The revised classification system of Feachem et al (1978) and Cairncross et al (1978) is defined:

1) Fecal-oral infections;
2) Skin & eye infections;
3) Parasitic worms; and
4) Insect vectors related to water supplies.

Jackson states that this revised classification was adopted for his Ghana Upper Region study in October and November of 1978, and there is no doubt that this re-defined classification is necessary to establish the benefits of the pump supply of clean water.

The problem of this approach, however, is three-fold:

1) Most people treated at clinics are so sick with a multiplicity of ailments that the effects of one disease may bring about another, or at least evidence of symptoms.

2) The clinics and Bolgatanga hospital are not sufficiently equipped to bring about such fine definitions for the reasons previously listed, but mainly workload, and the viewpoint of the staff that such records go unnoticed except for short-

term studies carried out by non-Ghanaean individuals who supposedly deliver reports but do not bring about change in the process.

3) Thirdly, and paradoxically, because the re-definition in the revised classification is universally accepted, but not employed in the study region, such reports are labelled: "spurious", "without pattern", or "incomplete", and therefore subject to further studies which are eratically funded by the Treasury Department and therefore difficult to replicate.

Again, those who study the effects of an aid program prefer to report what they expect to see. Reality is rejected because such desperate circumstances are difficult to categorize into a scientific approach, with appropriate, and therefore academically acceptable terms, while attempting to convey the true urgency of the situation.

Malaria (Fra Fra - lisi lima)

In the period 1971 to 1976, reported cases of malaria in Ghana increased by 600% to over 440,000. Malaria, according to Wosornu (1977), is the greatest killer of the communicable diseases. The disease is referred to as "holeandemic" in Ghana, that is to say, it is found everywhere in the country.

Symptoms of malaria include the following:-

- sweating
- aching all over
- tinge of yellow jaundice
- high fever
- diarrhea
- feeling miserable, depressed, fatigued

Malaria is also known as swamp fever, swamp miasma, intermittent fever, or ague. It is caused by biting mosquitoes which breed in stagnant water in ponds, dug-outs, irrigation ditches, discarded open cans, scrap motor tires, and pools of water surrounding water pump sites.

The infection is caused by single-celled blood parasites, animals of the phylum Protozoa, in the genus Plasmodium. The life-cycle of the human-oriented malaria mosquito includes a phase of asexual growth and development in the infected person, and a phase of sexual multiplication in the mosquito. The infected person is therefore classed as the secondary host, and the mosquito as the primary host. The human phase of the cycle begins with free-swimming elongate, microscopic forms known as sporonqoites which enter the body through the skin. They are present in the salivary secretion deposited by the bite of a malaria-bearing mosquito. These organisms enter the red blood cells, where they grow and multiply at the expense of the cell, destroying it completely before bursting forth to invade more cells. The eruptions of successive crops of parasites from the red cells correspond to the bouts of fever which recur every two to three days, depending on the type of malaria contracted. The anemia of malaria results from the destruction of the red cells, and more extensive damage is done to the infected person because of the tendency of the parasitized cells to form clumps or adhere to the walls of small capillaries, and impede or arrest the circulation of the blood.

The benign tertian malaria symptoms begin six to twenty-one days or longer after the bite of an infected mosquito. There is a succession of chills, each preceding a bout of high fever, with a duration of approximately eight hours, and tends to recur every three days or more often if the infecting bites occurred in more than one day. The rigors are accompanied by a rapid pulse and a fall in blood pressure, followed by perspiration. At the height of an attack there may be nausea, delirium, and even coma. Cold-sores may develop on the lips, together with itching of the skin. Anemia and a palpable enlargement of the spleen are frequent complications. Disturbances in the function of the various organ systems such as the nervous system, gastrointestinal system, and kidneys, usually follow. For this reason, as mentioned earlier, malaria is classed as a great imitator of other diseases. In the Plasmodium vivax-type of malaria, seen to be common in the Upper Region, the number of parasites in the circulating blood usually reaches 20,000 or 30,000 per cubic millimeter and rarely more than 70,000. The number of red cells being affected may be 10% to 40%, and since in Plasmodium vivax malaria there is a greater tendency towards obstruction of small blood vessels, fatal cases in Bolgatanga Hospital show obstruction of the small blood vessels of the brain.

Blackwater Fever is a serious and particularly alarming complication of malaria. There is a rapid breakdown of many red blood cells, and impaired kidney function. The urine of the infected person is red or black and is loaded with albumin.

Wosornu (1977) observes that in earlier years Ghanaeans could be taken to court for not destroying mosquito larvae in their homes. Wosornu suggests that people tried to beat the health inspector at his own game, not recognizing the essential nature of the legislation.

He further suggests that early Ghanaean campaigns to eradicate malaria were perhaps too ambitious, certainly very expensive, and did not yield visible results. There was also the factor that people wanted to acquire chloraquine, a drug, a medicine - the quick answer. The doctors supported this popular approach in the interest of increased fees for consultation, blood tests and injections.

Anti-malaria drugs are effective in preventing or arresting an acute attack of malaria, but not in preventing the infection from taking place or in eliminating it completely. Quinine, quinacrine ("atabrine") and chloraquine phosphate ("white atabrine"), in proper doses may be expected to control an attack of malaria in twenty-four to forty-eight hours.

Most people in the study area have become immunized by infection in infancy. People who survive their childhood infection remain protected against the local strains of malarial plasmodia although they continue to act as carriers. The main problem in the Upper Region is the apparent importation of new strains of mosquitoes, or if a person moves to a region where a different strain is prevalent. Most Upper Region adults carry plasmodia fal cipurum and plasmodia vivax without being disabled, but succumb readily to new strains.

Amoebic (Amebic) Dysentery:

Protozoa are one-celled animals that may be fifty times larger than bacteria, but still can not be seen without the aid of a microscope. One of the most common of these germs is the ameba-type, some of which cause amoebic dysentery by invasion of the intestines. The effects involve inflamation of the lining of the large gut, together with gripping pains and diarrhea with stools mixed with slime or blood or both. The disease is spread by the fecal-oral route: a person ingests food or water contaminated with protozoan (amoebae or ameba). Protozean of amoebic dysentery may also be present, not only in bore-hole sources, but in the pipe-borne systems, to be discussed in Chapter V , because some protozoa resist the effects of chemicals used for purification.

There is no doubt that in the Upper Region the main occurrence of this disease is where human excrement is employed as a fertilizing agent, which is in fact a social tradition in at least the rural areas of the Upper Region, and where small gardens are cultivated in the few urban centers.[2] The amoebae are passed out in stools.

Infection from the amoebae can be prevented by taking the proper sanitary precautions with food and water in areas where public sanitation is poor. The disease is often passed on by the people who prepare food in the compound and who may not know that they are harboring the invisible cysts of this parasite. This is common because people with the mild variety of amebiasis may experience only minor symptoms such as fatigue, headache, occasional nausea, flatulence, and bowel irregularity, all of which are common symptoms among the people for many other reasons. These mild forms experienced by most of the population often develop from amebiasis into the full amoebic dysentery, with pains in the lower abdomen, increased secretion of slime from the intestines, bleeding ulcers, diarrhea with blood and slime, loss of prostate fluid and, in most cases in the study area, chills and fever. If the parasite travels to the liver and produces an abscess, then results are usually fatal, or hepatitis develops as a complication.

Three drugs may be used to treat the disease, assuming these drugs are available and the people are available for treatment to be offered. These drugs are flagyl, ernetine, hydro-chloride, and tetracyclines.

Schistosmiasis:

This disease, also known as bilharzia, is again indicated by blood in the urine and is caused by small worm-like parasites which enter the human body through the skin of a natural orifice. Burrowing their way in, the parasites enter a blood vessel and then are swept passively through the bloodstream into the lungs where they burrow through tissue, entering the blood in the heart. From here the parasites spread throughout the body. In Ghana, intestinal schistosomiasis is caused by the schistosoma mansoni. Urinary disease is caused by schistosoma haematobium. It is common in the area of study to find people with both types of disease.

The infection is transmitted to certain fresh-water snails via exreta contamination containing eggs of the parasite. These snails transmit the infection back to humans by way of water contaminated by the infective organisms. Infection is usually acquired during domestic, occupational and recreational contact with contaminated water. In general, schistosoma mansoni is transmitted through the snails of the Biomphalaria group, and schistosoma haematobium through snails of the Bulinus group.

While infection is found in all age groups, frequently the highest infection rates, and often the highest intensities of infection, are found in children between about ten and fifteen, or twenty years of age.

Symptoms include:

- severe itching of the skin upon entering fresh water
- blood in urine or stool
- pain in the chest, abdomen or lower abdomen
- back or waist pains
- bloated abdomen
- shortness of breath, severe cough, blood in sputum

Treatment is by use of tablets and injections of ambilhor when available but the treatment often fails, not only because of the lack of drugs, but due to the difficulty of retaining the patient to provide long-term and consistent dosage.

While the methods used to treat symptoms and each detected disease may be understood by the available trained personnel; and while drugs are made available to treat those who select the Western approach to tropical disease control, the problem of improving the health of the population remains complicated by the continuing presence of traditional medicine.

The Role of Traditional Medicine in the Community Health of the Rural Upper Region:

In the rural areas of the Upper Region of Ghana, traditional animist-based medicine remains a viable medical system coexisting with scientific medicine and capable of adapting to changing social needs and new situations.

Traditional medicine includes herbalists, divine healers, spiritual healers (ju ju men or tiba), cult healers, fetish priests and priestesses of the various gods, or spiritual agencies of animism.

Twumasi (1975a) writes:

> "The essential factor in the practise of traditional medicine is the utilization of magico-religious acts, concepts and symbols in the practise of medicine."

The philosophy underlying traditional medical theory, or perhaps more accurately, local animist tradition, is quite complex. Briefly stated, the evil act by another person, or intervention by a spiritual agency, may cause illness or disaster. For example, when the writer developed a right-leg infection (doubling the size of his leg) as the result of accidentally striking his leg on the wooden frame of a bed, this was interpreted (in the darkness of a mud-walled room by the tiba and his two invisible but apparently audible ancestor advisors) to be in reality the action of "Emu", the silver snake of the tree, who became offended when the writer struck the frame of the bed in the darkness of night, when all 'good people' should be sleeping.

As Twumasi observes, the belief is supported by the religious dogma of ancestral worship which holds that ancestors protect the living who must obey the rules and regulations of society. Serious illness, therefore, is not attributed to natural causes or lack of hygiene, but rather to supernatural causes. The contracting of the disease by the individual (nera) is therefore inevitable and has no connection with the consumption of clean water.

Traditional medicine therefore, more than simply curing illnesses and healing injuries, has performed the function of social integration and control. Anti-social behavior on the part of a sick person, or those close to that person, explains many illnesses that are contracted, therefore, to cure sickness requires the righting of a social wrong. The writer, for example, was required by the tiba and his spiritual advisors to attempt an appeasement and, therefore, forgiveness of Emu, by standing beneath a large tree, in darkness, and playing an ornately-carved shepherd's pipe for seven consecutive evenings, after which the swollen leg reduced in size[3] resulting in great jubilation on the parts of those concerned in the village in which the tiba resided.

Members of that village and the families of sick individuals realize, therefore, their interdependence on their relatives and others in a household; therefore, a breach in their relationships threatens almost the very survival of the social unit.

Health and illness become the means for detecting threats to the social unity of the group, whether a household or a village, and for the re-establishment of the harmony of the group.

Twumasi further states:

> "---- the threat of suffering becomes a powerful incentive for moral behavior and the cure of the suffering becomes a sign denoting that the gods and the ancestral spirits are pleased once more, and that the society is restored to moral good health."

While Ghanaean city dwellers, influenced by Western education, Christian and Islamic religions, and access to cash income, have been released from this traditional philosophy. In rural areas the traditional healers remain very active with younger men replacing old. They maintain considerable power and influence with the local Naba and in community affairs and views.

Cases have been cited where local parents refuse to take their sick child to a hospital or clinic because the traditional healer has instructed that the child was predestined to die and nothing could, or should, be done about it. Further evidence on rare occasions is revealed that individuals who have had serious disease detected at the local hospital or clinic, and have begun treatment because of threats and chastising from village healers. While much in the success of herbal medicine and indeed social control must be admired by the Western observer, the major reason for resentment towards the traditional practitioner is the use by them of enemas to cure nearly all diseases. Cases were cited where patients were given poisonous enemas. The anal area being one of the most absorbant areas of the body, the patients may readily suffer severe respiratory distress and die as a result, from herbal toxemia. A further problem is the use of orally-injected enemas by older women as a long-standing traditional cure for diarrhoea in small children. These women, in general, have little knowledge of the appropriate use of herbs in the treatment of specific diseases, therefore, successful treatment is varied thus leaving the child vulnerable to the development of disease when scientific treatment could have had an arresting effect.

However, until effective Western scientific approaches to providing health care in rural areas can be consistently applied, the people have no recourse, and traditional medicine with its influx of younger healers must continue to serve the needs of their respective social groups.

Protection of Borehole Water-Supply Source:

As has been described, the risk of infection to the people from sources other than CIDA-supplied boreholes, is significant and the resulting damage to the general health of the population is severe. With this early knowledge it was essential that CIDA ensure the integrity of new water-pump installations. This was especially the case, since many hand-pump installations already existed, providing a source of data to be observed and studied, and the omissions of others to be accepted as low-cost field experience. This was not done. Water-pumps and concrete pads of the type to be found in many Canadian provincial and national parks and campsites, were provided. Therefore, all adaptation to suit physical conditions and site-behavior of the rural consumers were, or are being, carried out as modifications subsequent to installation or at least, after dispatch from the manufacturer's plant.

In 1977, Wardrop & Associates reported that:

> "there are sufficient indications of continued contamination to suggest that there may still be a problem to the bacteriological quality of the water. Sources of contamination may be associated with well-head conditions, or may be associated with hand-dug wells and surface-filled depressions in the vicinity of the well sites" *Wardrop & Associates 1977a*

Suspected sources of contamination of the CIDA-project wells included:

1) Waste water entering the pump by way of the pump base;
2) Pollution entering through hand-dug wells, abandoned wells, surface water-filled depressions in the vicinity of the well site;
3) Infiltration from animal-watering ponds near the well head;
4) Seepage under the pad and down the outside of the concrete well-casing.

While an "intensive, water-quality monitoring program" was proposed by Wardrop, involving forty-eight boreholes, in the Bolgatanga district, the testing was not completed:

> "in view of the relatively large manpower commitment involved, the non-critical nature of the problems relative to the host of other priorities faced by the well maintenance and Project organizations," Wardrop 1977a:16

Some testing was completed and the results found to be within the 20+ coliform danger level limit, with contamination studies "inconclusive" and as displaying "no patterns".

Jackson (1978), states that bacteriological sampling involved the use of the Millipor technique to determine coliform bacteria.[6] Upper Region Water and Sewage Plant geological technicans were able to test three-to-four wells per day. Usually, tests were made at each site. The first sample was taken after the well had been pumped for several minutes steadily. A second sample was taken after prolonged pump use. A filtration process was employed at the well site and two mobile incubators were used, one for fecal coliforms and one for total coliforms. The coliform count was determined twenty-four hours later in Bolgatanga. Officials of GWSC noted at the time that the incubators, costing approximately $2,000.00 each, together with a driver, a vehicle, fuel and a technician, makes the testing process expensive and therefore only to be practised when requested, not as a routine requirement.

Observations in the study area during September-October 1981, showed most sites to have some form of concrete base, but with many worn and cracked. Often there was stagnant, algae-covered water in shallow depressions on the bases. Some bases sloped in all directions. The most effective base appeared to be those provided with a long cement drainage trough attached, a subsequent add-on modification, subject to detachment due to the lack of reinforcing bars between pads.

In several cases the splash-water drainage from the pump itself was inadequate. Pools of stagnant water had formed around the base of the pump, attracting insects. A number of sites had animal watering-holes located five to twenty feet away from the pump, but ditches for drainage to the holes, in some cases, were not well-maintained. These watering-holes serve as a breeding area for mosquitoes and flies.

In a number of cases, pumped water was returning down the shaft through a gap in the base of the pump, and in other cases, the pump casing was broken just above the mounting flange, as anchor studs and nuts had worked loose because they had not been tightened.

Discussion with GWSC officials provided no evidence that checks were made to establish if the concrete ring-formed borehole shaft lining was water-tight to avoid ingress of polluted water down the side of the casing where back-fill around the concrete base was eroded or absent.

In those areas where a watering-hole was located, adjacent to the well, the stagnant water, cattle feces and the presence of insects, indicated a potential for watering-hole contaminating borehole water.

Defacation by people in nearby fields could serve as a rainy season danger when the run-off contaminates nearby ponds, or watering holes, or when the fecal material soaks directly into the water table.

Rectification of Inappropriate Design Technology:
Many of the pumps installed are by design contributory to borehole contamination, however, it is difficult to direct blame to the pump suppliers if the CIDA specifications issued to them, with the tender documents, did not incorporate technology appropriate to the site conditions or social behavior of the rural consumers. It is rare that a supplier of equipment to a CIDA project is sufficiently courageous, high-principled and patient enough, to challenge the appropriateness of the technology contained in a CIDA-approved specification. There is copious evidence that such challenges are bureaucratically circumvented by the CIDA officials involved at that time, and, while the frequent staff turn-round policy of CIDA continues, most officials involved on a project at the time of tendering, will have moved on to a different section of CIDA before the errors and omissions of the contract come to light. No responsibility is therefore accepted and the errors and omissions remain for perpetuation in future specifications.

Most sites had concrete bases properly surrounded with back-fill. Some of the essential back-fill was in good condition, however, wind, rain, human and animal traffic, were eroding the back-fill material. The best back-fill material appeared to be where round (pudding stone) rock was utilized, rather than sand.

A Unique Section Condition:

Examples of the lack of attention to specification detail may be such items as: the significant pollution of boreholes by sand (brought to site on the feet of water-pump users) working beneath the pump stand into the borehole casing. Ingress of sand continues, even though the borehole casing extends some 10 centimeters inside the pump barrel, and the pump stand is installed on a rubber joint placed between the pump base and the concrete well-head support base, or pad. This movement of sand is created by a vacuum which may be logically understood by a brief study of the pump design, but in field practise, only occurs in a condition of continuous pumping, as in the case of almost all pump sites, and for a large part of the day. These undesirable vacuum conditions in the stand of the pump were rectified with a program, carried out at the convenience of the staff, to drill two small air-vent holes in the pump stand, about 30 to 40 centimeters above the concrete base on which the pump is mounted. At this point, all new pumps were ordered with the vent holes drilled. This simple design-change greatly reduces the potential for borehole water contamination, providing the feasibility exists for the staff to carry out the modification, together with associated repairs to all affected pumps.

Grouting-in a Raised Casing Estension:

A further indication of the lack of thought given to the obvious nature of water-pump site conditions is the late realization, by CIDA-Wardrop engineers and technicians, of the benefits of making the entire lower section of the water pump (i.e., pump stand and barrel) an integral part of the concrete pad, or head, which covers the borehole. If a section of flanged steel pipe is installed as a vertical extension of the casing when the concrete is poured, the installation can then be said to be "grouted in"; a basic engineering method (which has been practised for well over a century) of excluding the ingress of corroding fluids and leaking oils around stationary machinery.

The Need of a Shortened Pump Barrel:

The grouting-in method requires the agreement of the water-pump manufacturer to supply a pump having an especially short barrel. By using a vertical section of pipe, the first flanged connection of the hand pump is kept some 30 centimeters above the surface of the concrete pad on which the consumers stand during pump operations. This method, of course, virtually eliminates any borehole contamination from sand that may be brought to the site on the pump users' feet. The air-vent holes, described earlier, should be drilled in the barrel section of the hand pump, as added assurance against the unique vacuum build-up, but in this case, to act as a leak-off for the increase of pumped water from the top of the barrel.

Since the majority of water pumps installed are not grouted in and are therefore subject to this type of borehole water pollution ingress, a further associated problem is evident. The four anchor bolts holding down the pump stand to the concrete pad are in most cases loose. The reason is that;

a. the anchor bolts were not grouted in with grouting type cement but secured when the pad was poured, i.e., using the same lower grade cement;

b. the lock washers were not fitted originally, or have been lost;

c. the studs worked up or, as can be anticipated, the concrete contracted leaving the nuts loose, coupled with the possible absence of the customary second pull-down after the concrete has cured;

d. the nuts have been lost and are not available in Ghana as general stock. They must be brought in, using CIDA funding, either from Canada or Upper Volta;

therefore, when the grouted-in pump stand form of installation is applied, there is the potential of bolting at the first flange-to-flange joint as already described. This has the advantage of being secured with nuts and bolts rather than studs in concrete of doubtful holding quality.

The method also has the advantage of bringing the joined section of the pump closer to the pumping action, thus lowering the stress on that joint.

It is therefore highly desirable that the policy of installing casing extensions should be carried out to overcome the vagaries of pump-site social behaviors, together with leaking casing connections which bring about a certain contamination hazard to any affected well.

There are at present few examples of this grouting modification in existence on the project, and no evidence available on the remifications of any future installations being originated in this manner.

From the planning aspect, however, and as part of the community development principles to be employed, some careful considerations must be debated here on the further merits and disadvantages of the grouted-in, anti-polution approach.

1) The Continuation of the Current Policy of Mixed Pump Types on a Single Site or Area:

At this time, whenever a pump is fitted to a concrete pad, whether as a new installation or a replacement, any available pump is selected, and the studs are grouted into the surface of the pad to suit the configuration of the pump mounting flange. While this practise appears to be acceptable, the end result is a potential mixing of pump types in any given area.

If the casing-extension policy were established, this practise could not continue unless adaptor plates or adaptor bobbin spacers were fabricated to suit a limited selection of pumps.

Under such circumstances the feasibility does then exist for the contractor to supply say, three different makes of pumps of similar design which would, with the provision of adaptor bobbins, provide a choice of three pump heads to fit a common, grouted-in base.

Since it is already necessary to make the supplied pumps non-standard, by the requirement for shorter barrels, the provision of adaptor bobbins by each manufacturer should raise few problems. Whether the pump barrels are cast or fabricated, the adaptor bobbin would always be fabricated steel and therefore would be easily manufactured locally.

However, this approach may be considered only as a realistic solution to a problem existing in the area of study;

a. as a required method of eliminating ingress of pollution;

b. as a means of rationalizing the large variety of pump makes and types existing in the area following the trial-and-error approach to appropriate water pump selection employed at this time.

Such an approach, if utilized by CIDA, would have the disadvantages of;

a. no clear comparison of water pump performance;

b. no clear comparison in the effects of differences in pump site social behavior;

c. no facility to conduct technical and sociological experiments at pump sites;

d. no clear feed-back to suppliers, thus allowing a lapse of interest essential to maintain design change incentive and commercially viable research and development cost justification;

e. high potential for spares supply confusion, from GWSC central supply source to pump caretaker.

However, it may still be argued that, having a variety of pumps in one location, lowers the potential of canibalization of spare parts, that is to say, if parts are not readily available from a stores source, the required parts may be taken from another damaged or indeed an operating pump after agreement is reached on which water source is to be closed. It is better to have some pumps in operation by way of canibalizing parts from similar pumps, than have a number of dissimilar pumps all requiring repair, but lacking parts.

2) Three Pump Types in Segregated Areas:

The alternative concept of operations, having agreed on the grouted-in casing extension, would be to again select three pump types, by joiningthe values of sociological and technological experience gained from the previously described in Wardrop-conducted field trials.

Each pump type would then be installed exclusively in given areas. This policy would provide the desirable facility;

a. to allow for clear comparison between manufacturers and types together with any variation in pump site behavior in a specific section[4];

b. to allow for democratic assessment of water pump tenders and in the awarding of contracts to the suppliers of the most appropriate pumps;

c. to conduct technical and sociological experiments in one or two of the areas while retaining the third as control area;

d. by using three different manufacturers, all three suppliers would be kept vitally interested in competing and, therefore, honest in tendering for additional units;

e. by using three suppliers, two escape sources would be allowed in the event of exposure of major defects in one;

f. by using only three suppliers, the spare parts would be rationalized into three types, in three separate areas, which would avoid shipment of incorrect parts to a village caretaker;

g. by keeping the sections separate, confusion by pump caretakers and GWSC personnel alike would be avoided, when more than one make of pump is installed in the same village;

h. by having three separated sections, interchange of caretakers between sections would be allowed, thus experience and confidence on pumps would be gained, once relieved of the harrassment of close relatives, neighbors and local elders[5];

i. Given the opportunity to share with two competitors, the lucrative penetration of an otherwise inaccessible market, and the opportunity to have a product compared in field operation experience, is likely to result in the design and supply-cooperation of preselected hand pump manufacturers to achieve this end.

j. Segregating the pump types to a given area would avoid potentially costly design change to accommodate a universal adaptor bobbin spacer. Each pump type would simply bolt down to a matching flange on a pre-installed grouted casing extension.

Custom Concrete Pad Design and Self-Help:

One of the more important features of water pump site protection is the design of the borehole head which also serves a base or pad on which water pump is mounted. Mention has been made of the variation in shape and condition of these pads, yet little if any consideration was given to this fact at the time of design in Canada, the original object was simply to cover the drilled and lined borehole, while at the same time providing a mounting base for a pump and some reasonable space for water collectors to stand when pumping. No consideration was given to the fact that women in Africa , and indeed Europe, found convenience and pleasure in, for instance, washing their clothes or utensils at a common water source, rather than waste time, and their sometimes sparce energy, manually transporting their water from a distant, space-restricted and undrained compound.

It is not acceptable to state that, providing a minimum-sized concrete pad encourages village self-help groups to extend the CIDA-supplied base into a large, drained working area, because, without reinforcing bar extensions from the central pad, any additional concrete structure will, in due course, separate from the central pad and encourage the ingress of waste water under the pad and into the borehole, thus creating a further source for mosquito-breeding and producing an unpleasant odor.

Self-help projects of this kind were encouraged by Wardrop and Associates' staff, on behalf of CIDA, as a means to stimulate a feeling of pride in ownership, and to encourage the water-collectors to keep the area clean. This approach appears to be accurate and successful, more especially when compared with the condition of non-extended pads, as will be discussed later in this chapter. However, as and when the concrete begins to break up and separate, the traditional fatalistic attitude of the people may change their present concern for a clean and tidy site.

It is not difficult to arrive at the conclusion that part of any ongoing maintenance program funded by CIDA must include converting each and every site to be equipped with a standard design of apron. Wardrop and Associates are prepared to complete such an apron which Lloyd McGinnis describes as including:

> The placement of grooves to channel the flow and proper sloping of the concrete pad, which is constructed to a height of approximately 50 cm above grade helps keep the pad clean and facilitates draining splash water a distance of 15 to 20 meters to an easily constructed animal watering hole. Water is precious - none of it should be wasted if it can be put to good use. Concrete curbs around the outside of the concrete well-head pad are not needed and should be avoided. Such curbs tend to create unnecessarily poor sanitary conditions.
>
> *McGinnis 1982*

On installation, the concrete pads measured only 81.5 cm (3') wide; 182.9 cm (6') long; and were 30.5 cm (1') thick, and remained approximately 50.0 cm (19" to 20") above-grade; hardly a workable area to keep clean, and more specifically, with no reinforcing bar provision for extension achieved by local incentive.

Community Participation in Local Maintenance of Water Pumps:

From the evidence of stop-gap and inadequate measures applied in the Upper Region by the hard-pressed CIDA cooperants involved in the Water Utilization Program, no consideration was given by CIDA to the program of ongoing water-pump maintenance. There appears to be no evidence to establish whether GWSC personnel or village authorities would be responsible for maintaining water-pumps as and when they were commissioned. The evidence is that CIDA (with other donor agencies) was prepared to supply boreholes and pumps to the Ghana Water and Sewage Corporation for rural, clean water-source purposes, while at least jeopordizing any initial success and goodwill, by not providing the backup service and spare parts integrity which is the very essence of survival of any part of the Canadian private sector. Quite obviously, the mere fact that GWSC required aid in the first instance indicates the need for at least a contingency program suitably financed to provide initial maintenance and of course the knowledge as to which part of the social system these Canadian funds are to be responsibly channeled.

At this time, however, CIDA expresses a realization, some eight years after the first water-pump commissioning,

> "that is becoming increasingly evident that the success of local maintenance, and full realization

> of potential health benefits from new water supplies is tied to the extent to which villagers participate in the program. The earlier the involvement the better ------ Ideally, villages should participate from the very onset".[6]

At the present time problems, seen by both CIDA representatives and GWSC as the responsibility of water consumers, range from the mechanical - the care and maintenance of the water hand-pumps and well-heads, to the social - an ingrained disposition among the villagers to the use of traditional water sources, mainly surface ponds, and a disinclination towards maintaining the cleanliness of the well-site in which the choice of water source may be a matter of convenience rather than cleanliness. Project Phase I reports from Wardrop and Associates, supported by subsequent WUP reports, have noted that:

> "Water spillage at site attracts livestock and creates a water-pollution source."
>
> "Pollution of water-supply occurs after pumping through dirty storage facilities."
>
> "Many people do not differentiate between the purity of well water-supply and the polluted source of water in ditches and dugouts."
>
> "If there is a lineup at the pumps, the people go to the trough."

In all of these reports no mention is made of any degree of responsibility of CIDA or GWSC as suppliers of a fully-integrated rural, clean-water source of supply which if exercised may have approached villagers prior to the onset of the drilling program, if only from the basic community development principle that people tend to support change they help to design and, likewise, tend to resist change they do not Help to design.

Although the cybernetic approach was applied in the CIDA-initiated NORRIP project around the town of Tamale in the Northern Region of Ghana, the decision to supply water to certain areas was the responsibility of GWSC officials posted in from the south as discussed in Chapter V and with a maximum interest of five years in the region. Understandably these officials are influenced by the stream of representatives of vested groups and civic officials who trail constantly into the office of the GWSC Regional Manager in Bolgatanga to seek audience on such matters. In interviews with fifty-four female water-users, conducted in the Bolgatanga - Bawku areas, none was involved in meetings or interviews to discuss whether or not they or their fellow villages wanted water-pumps. Likewise, none of the respondents was aware that anyone but the government was responsible for pump or pump-site maintenance, although many agreed that individual women took upon themselves a natural crusade to discipline water-related behavior of both people and animal users alike. They furthermore considered educational talks by WUP representatives on long-range implications of costs, local maintenance, pump caretakers, protection of supply site, proper water utilization, hygiene and sanitary practises, to be friendly advice to be accepted or rejected by the recipients at will. The Naba and his sons were the only persons who could set laws to be obeyed by all the villagers.

The Canadian WUP teams commenced operations in the area of study in early 1978 employing locally-acquired GWSC staff and visiting remote villages by pickup truck and light motorcycles. Each team was ideally composed of an Adult Education Advisor, a Community Development Advisor and a Site Development Advisor who were operating on behalf and funded by CIDA, but under the direction of the GWSC official responsible for rural water-supply maintenance.

The team immediately adopted the role of social animateur, gaining the confidence of the villagers before new ideas were transferred to them. Self-help systems were arranged, with local Nabas and villagers encouraged to supply and transport shingles and sand for initial application and replacement of site back-fill. An attempt was made to instill a sense of ownership of the village water pump but since the long-term understanding was that the GWSC was providing and therefore maintaining the clean water-supply, the general feeling was one of ambiguity and in such cases the villagers tend to do what they know how to do rather than to attempt, on a long-term basis, a new behavior.

Regrettably, CIDA officials appear not to have recognized the need for advising GWSC to foster village participation from the onset of the project, and to apply a cybernetic approach to enhance the probability of rural water-supply consumers taking responsibility for the hand-pump. This in turn would have paved the way to gain full benefit of a potable water supply through improved health enjoyment.

This late realization, or at least adoption of basic community-development practises, results in an apparent reluctance to pursue it. The task of rectifying this omission on this particular project is enormous. Furthermore, if such a practise is adopted, the lead time for contracted engineering consultants must be increased before actual water-supply construction, or indeed the ordering of equipment and supplies or specification preparation, can commence. Substantial extra time, energy and funding must be committed to this approach but, what is more important here is that the role of the sociologist in such projects is at least as important as that of the engineer or technologist. While the project by nature is technical, its initial and long-term benefits are purely sociological.

The Need for Education on Water Quality, Site Sanitation and User Hygiene:

Aside from all criticism which may be levelled at the CIDA-initiated Water Utilization Program in the Upper Region, the facts remain that major program directions must be applied to avoid the provision of water pumps in rural areas being a costly failure, both financially and in loss of expectations by the trusting populace. The four most critical educational needs appear to be:-

a. Water-quality monitoring
b. Water-pump site sanitation and hygiene
c. Sanitary and hygienic water-use in the compounds
d. Excreta management in all areas

The learning must be achieved by:-

a. GWSC site inspection and maintenance personnel
b. Village-level pump caretakers
c. Village water committees
d. Villagers/Users

The actual learning may be more practically achieved by groups a, b and c, with group d being subject to enforced norms applied at a given site. Since sites vary in location and physical environment, no centralized aggregate policy can be applied. Norms established for each site must be specifically directed to suit actual facilities and physical conditions prevailing.

Regular and frequent monitoring [7] is required for all CIDA-project wells and should not be divorced from the Water Utilization Program regardless of whether the program continues to be the responsibility of a CIDA-financed group of cooperants, or is handed over to the regional government. That is to say, monitoring and recording of contamination is not enough, the source of contamination must be tracked down and corrected with the least possible delay, which again requires a coordination of both technological and sociological factors known to exist in well-pollution.

Moreover, water-quality monitoring is required for traditional, unimproved sources and for water in use in the compound storage. Detailed testing and record-keeping is required but it must be carried out with the sole purpose of determining more precisely where contamination or disease transmission is taking place, and appropriate corrective and educational action must be taken.

In 1978 WUP staff, recognizing the village caretakers were mainly illiterate, and in any instance, lacked mechanical skills, set up a system wherein the caretaker was issued with a number of copies of a hand-drawn water pump, together with stamped and addressed envelopes. In the event of a failure the caretaker simply marked an "X" against the offending part and mailed it to GWSC office in Bawku or Bolgatanga. The GWSC maintenance crew and WUP staff were then required to respond with parts and service. There are no rural post-boxes in the area of study but there are postal agents in major villages. Taking the service request to the mailing agent often required a walk of several kilometers for the caretaker or the entrusting of the report to someone "going down the road". As gasoline became increasingly rationed in the Upper Region,[8] the mail was collected infrequently. Those reports received by GWSC could not be responded to with any urgency, again due to the lack of fuel for WUP and GWSC staff and later, the lack of serviceable vehicles became a mutual problem. In addition, where a pump caretaker became responsible for a number of water-pumps, the report forms became mixed and since there are no radio or telephone communications, often the arrival of the WUP or GWSC crew was met with the absence of the caretaker and the need to tour the bush area to locate the offending water pump which often had been repaired in the interim period. Each visit to a pump site can therefore involve some 100 to 200 Km of travel by pickup truck or motorcycle.

There is also the problem of trust: The opportunity to retain loaned tools,[9] to sell them to mechanics or farmers owning mechanical equipment, is available to all pump caretakers: The water-pump caretakers selected by the village or community committees often refuse to give their names to CIDA WUP personnel. This may indicate villager acceptance of these possibilities together with the opportunity to claim the loss of tools. The practise of withholding names also avoids identification in the event of complaints by villagers of "dash" acceptance by the caretaker in return for a priority in the provision of very scarce pump spare parts and for expedient maintenance of water-pumps supplying the more affluent or influential villagers.

There is therefore no alternative to the central training school in which selected and GWSC employed pump caretakers are fully trained on both hygiene and water-pump technology. Had this requirement been addressed by

CIDA similtaneously with the commissioning of the pumps in a given area, the responsibility for pump and pump-site maintenance would have been in place, with a minimum of central source assistance being required.

A further logical program sequence may be: the requirement of GWSC personnel to be trained in water-quality testing methods (such as the regionally-proven Millipor technique), followed by systematic training and reporting of pump caretakers. A system of regular communication of the results and implications of the monitoring to the villagers involved, must be an essential feature of such a program - to retain a trust in the hand-pump water-source system as a principle in improved health levels for the community (though varied and somewhat hypothetical, whereas pump problems are both tangible and logical; and highly evident in most cases).

Even with improved sanitary pump caretaking, disease transmission at any given site is not necessarily eliminated. A male pump-caretaker is likely to have little effect on the water-related behavior of the women users: Practises such as scouring calibashes with backfill material, permitting cattle and small animals, together with children, to defecate in the vicinity of the pump must be changed by normative adjustment. It becomes essentially the function of the village water committee to set regulations and to impose sanctions on those who do not adhere to site sanitation rules. To achieve this action successfully, on what must be essentially a long-term basis, the committee members must be well-educated as to all aspects of water utilization and employ the pump caretaker as a watchdog fully cognizant of the value of his work.

The water committee must also extend their knowledge to appropriate water use in the compounds, including collection, storage, washing and bathing, waste water and communal water use. Traditional water sources, and animal faeces in the compound, with accompanying flies, are examples of likely disease transmission factors.

There is also the problem, specific to each village, of uneven use of compound and community latrines. Use of the fields is by far the most prevalent means of human excreta disposal. The problem, during the wet season, of faecal material being washed into the water sources, is a variable factor possibility, of which must be the interest of the water committee.

Perhaps the most significant factor of user-education is:

a. the clean-water users are predominently women;

b. this being the case, the women must be the primary learners;

c. WUP naturally utilized a Canadian female Adult Education Advisor to approach the women;

d. the women were receptive to the advice given and understood the logic of that advice;

e. the men have the authority and therefore as a point of principle, they rarely accepted the approaches of their own women or those of the WUP female representative.

A further serious resistance to the effective work of the WUP in the study area was a shift in policy following the departure for Ottawa of a long-term and highly successful CIDA cooperant in 1982. The new policy called for a further expansion into community development by establishing schools to provide education on hygiene and water utilization, with children and women water collectors as the target learners.

While this novel feature appeared at first sight to be a very positive approach, the move from teaching as a complementary function to GWSC, around the water pump or under a maize stalk-thatched canopy in the village centre, to a school class room, automatically transferred the civic administration responsibility from Ghana Water and Sewage Corporation to the Ministry of Education. This placed the Regional Manager of the GWSC in the position where staff under his jurisdiction and funding were overlapping the well-guarded responsibilities of a manager of equal status in the Regional Ministry of Education. The Regional Manager of GWSC felt threatened by being placed in an embarrassing position by an outside force apparently encroaching on an alien area of concentration for their own ends. He also felt that his apparent advocacy of this action on the part of WUP could be misconstrude as empire-building by the local AFRC revolution-appointed administration with violent military-style repurcussions. His reaction therefore was to adopt the policies of -

a. limiting the availability of vehicles to which the WUP group had hitherto enjoyed exclusive possession and -

b. excessively delaying approval of gasoline and diesel requisitions which he alone signed.

The group has become thereby somewhat redundant and isolated from the essential program required to at the least attempt to instill site maintenance, village development and basic contamination principles among the villagers. The situation is exacerbated by the real rather than simulated transport vehicle and fuel shortage which will further jeopardize the intended extension of the health and maintenance program. The program entails a direct health facility providing clinical and public health nursing and epidemiology. This type of program is presently provided in a limited number of centres mainly by Roman Catholic nursing Sisters with regional headquarters in Bolgatanga and by the Dutch Reform Church operating from Bawku.

It is for these reasons that the appointed water pump caretaker must not be encouraged to complete his technically oriented task in isolation to the interests of the village water committee. While much has been described earlier to emphasize the need for appropriate water pump and site maintenance, such action in isolation will not improve health standards of the user community. The total process of water collection must be the basis for education on correct water utilisation.

Collectors walk with bare feet on and around the water pump-site area which invariably contains the faeces of cattle and goats as well as some human excreta. In addition, water collectors walk through the mud at the periphery of stagnant algae-covered water holes. Calabashes are placed in the backfilled region around the concrete borehole head. Hands contact the calabash which has contacted faecal material in the backfill. Both adults and children are involved in the water collection process.

A second area of concern is the cleaning of calabashes by scouring them with earth from the backfill around the pumps. The problem is two-fold:

1) The backfill is again polluted
2) The backfill in some areas consists of sharp sand which is not only polluted but due to its sharp nature embeds particals into the material of the gourd calabash and remains embedded after it has been rinsed and therefore supposedly is clean.[10]

Observations in 27 compounds (yire) visited in Bolgatanga, Vea, Gowri and Bongo indicated that almost 90% of the water collectors from those compounds carried water (ko-om) from a nearby borehole and the remainder admitted using water from other sources as a complementary supply or as an exclusive source. The water was collected primarily by women (poka) and some older children (kwama) mostly in the mornings and evenings.

The study indicated the average number of inhabitants per compound, all of which were arranged for extended families, was 8.3 persons. The average requirements for drinking and cooking in those compounds was 4.2 pots (doko), approximately 14 imperial gallons. All compounds stored drinking water in large clay pots which were found to be covered with a leaf, a piece of board, but mostly a calabash[11] (wanne). These clay pots (yoore) appear to be a safe, economical method of storage and also serve as a cooler by evaporation in a similar manner as the Persion water cooler. An average of 3.3 metal buckets (bogte) or old gasolene cans, or approximately 9 imperial gallons, is collected each day for Ablutions. However, since most of the residents of each compound included children, they would be required to bathe at the pump or, in the wet season at nearby dugouts, or from water drawn from an open well. Another two buckets on average was collected for small domestic animals and fowls if they were kept in the compound overnight. A further two buckets average per day is used for washing clothing although during the dry season most women advised that clothes were washed at the water pump site and then placed on the ground or on bushes to dry. Again the problem of faecal material,[12] of human, fowl and animal origin deposited around the site may contribute to disease transmission on the hands (nuuse) and on clothes.

The average amount of water collected per day for each compound at least during the dry season is 34 imperial gallons, all carried by way of head portage and involving ten trips to the water source. Of the 54 women interviewed from the 27 compounds, all said they liked the taste of the water from the borehole they had selected for use. Questioned on whether they thought the borehole water improved the health of their families, 42 agreed that to drink clean water (nyu ko-om soza) lowered the incidence of bilharzia (bozduurom) dysentery (yenereme) and more especially worms (bonkeese).

All women agreed that the installation of water-pumps in their area saved considerable time and energy especially during the dry season. The convenient supply of water allowed for collections of water for compound gardens during the dry season to grow cassava, cocoyam, sweet potatoes and other vegetables which was rarely attempted before water pump installation.

It was interesting to note that those women who had young children when they commenced using borehole water, found that in almost every case there was a marked increase in the occurrence of diarrhoea for a short period after the commissioning of a water-pump in a given area, followed by a decrease below the level existing prior to pump commissioning. This factor may be related to the difference in water quality between the commissioned borehole and the previously utilized traditional water sources. There may be required a period of adjustment until normal stools are produced when the new water is consumed.[13]

CHAPTER IV

FOOTNOTES

1. Dehydration is exacerbated by the absence during the dry season of the two to-three-quarts of fluid required normally to counteract the loss from fever-initiated persperation and loss from urination, and from stools. The required extra water intake is often not available.

2. Most people in the area of study utilize the fields, the bush, and in particular, their small gardens for urinating and defecating. One Fra Fra greeting, used in Bolgatanga area at least, is: "You have not fertilized our fields for many months". There is some truth and social justification for the importance of human feces as a source of soil fertilizer.

3. While the writer took part in the remedial process for research purposes, while also avoiding incurring offence to concerned Fra Fra GWSC workers, the cure was more likely achieved by the continuous application of a bandage borrowed from the Roman Catholic nursing sisters in Bolgatanga. The bandage, following the cure, was washed and applied to a less fortunate Fra Fra farmer suffering from an abscess of the leg caused by diet deficiency.

4. The coliforms are a group of gram negative, rod-shaped, lactose-fermenting bacteria native to the intestinal tract of mammals. They are members of the family of bacteria called Enterobacteriaceae and, like the other members, can be cultured from mammalion feces.

   Total coliform refers to species of Escherichia, Klebsiella, Enterobacter Serratia Citrobacter and Edwardsiella. All of these species except Escherichia can exist as free-living saprophytes as well as being intestinal organisms (ref.1).

   Fecal Coliform defines primarily Escherichia coli, and occasionally Klebsiella sp. They are distinguished from the total coliform by having the capability of fermenting lactose at elevated temperatures, as well as at 35°C, the optimum for coliform. The elevated temperature of 44.5°C + 0.2 has been shown to be the best temperature to select for coliform, especially of fecal origin. Any total coliform count may include fecal coliform organisms.

The reason for testing for Coliform is because epidemics such as typhoid fever, dysentery and cholera are caused by pathogenic bacteria transmitted via polluted drinking water. The organisms are difficult to culture in vitro. Water-borne intestinal parasites and viruses are an even greater challenge to laboratory analysis. Yet it is extremely important to be able to detect their presence in order to determine whether or not the water is safe to drink.

Coliform organisms, while relatively harmless themselves, are almost always present in water that contains enteric pathogens. Thus, because they normally survive longer than the disease-producing organisms, coliforms are a useful indicator of the possible presence of enteric pathogenic bacteria and viruses. In most cases, water that is free of total coliforms, is considered free of disease-producing bacteria.

Fecal coliform analysis is a more definitive test for recent fecal pollution than the total coliform test, and fecal coliform is the standard test organism used in many laboratories testing treated sewage, untreated public water supplies, and such primary contact waters as swimming areas in North America.

5. A. While the first approach in selecting a pump-maintenance mechanic is to seek out an individual in the village where the pump or pumps are located, the concept of transferring a useful mechanic to another village may often be to the benefit of all concerned. In a home village the mechanic may be harrassed and chided by the women who knew him as a child. Most families have relatives in several parts of the Upper Region, and usually in counties to the east and west. Therefore, a man may be transferred to a village at which a relative resides, and since his transfer was authorized by GWSC, he immediately commands respect as a "Big Man", merely on social principle.

B. Where total water and hygiene is the convinced concern of a Nabi it is sometimes necessary for his sons to become water and sewage overseers to enforce community rules established in reality by men in council, but applied in the domain of women.

6. L.R. McGinnis, P.Eng., W.L. Wardrop & Associates Ltd., Rural Water Supplies in Developing Countries 1982, p.13.

7. Initially, CIDA ensured funding and organization by way of the project consultant, W.L. Wardrop & Associates Ltd., of Winnipeg, Manitoba, for handpump maintenance during the installation period commencing in 1974, to consist of a visit every 15 days with a thorough inspection twice each year. By 1980, routine calls were made every 3 to 4 months, and at this time calls are made by the remnant of the CIDA Water Utilization Program (WUP) staff, as a failure is advised by verbal passage of notification, and as gasoline is made available for the sometimes 100 to 200 Km round-trip visits.

8. The few gasoline stations located in towns of the Upper Region are supplied from the government refinery in Tema on the coast of Guinea, approximately every three weeks. The station owner is advised with great difficulty by telephone, usually by way of the police station, when the tanker is leaving Tema or some other town enroute. Word is spread, and vehicles are left empty in a queue at the gas station for sometimes three days, to receive possibly five Imperial gallons for each car, and more for trucks. The largest fuel shipment is consigned to GWSC where it is the personal responsibility of the Regional Manager to sign all fuel requisitions for fuel dispensed to GWSC vehicles and other "deserving agencies and individuals", the latter also supposedly being involved in the cause of clean water distribution, sewage disposal and public health.

9. Mechanics and pump men are issued with:

Qty. 1 - 11/16" British Standard Whitworth (BSW) Wrench
Qty. 1 - 9/16" " " " " "
Qty. 1 - Pipe Wrench
Qty. 1 - Can of Grease

10. The initial Water Utilization Program team was lead by Ron J. Schatz, now serving as a CIDA officer in Hull, Quebec. A large number of very useful on-site studies were made over the years to 1982 to establish and educate the villagers on the degree of fecal contamination remaining in what they considered as absolutely clean calabashes after scouring. One of the most significant discoveries was the experiments of April 19th, and 20th, 1982, when Schatz and Ken Nordin discovered that, by simply placing a scoured calabash upright in the sun for 30 minutes, fecal contamination existing inside the calabash was dramatically reduced. While this may appear to be simplistic, the move to turn the calabash upright after scouring was completely against centuries of practice where the calabashes are scoured, washed out and inverted to naturally drain and to exclude the dust. They are never left upright except in error.

11. The calabash gourd (Lagenaria siceraria) is a tender annual, trailing vine; sticky, musky-scented and hairy with branching tendrils and round leaves which are sometimes 30 centimeters wide. The flowers are white, growing from 5 to 10 centimeters across, and wither in the noon sun; two kinds of staminate and pistillate are borne on the same vine. The fruits, covered with hard, durable shell, range from 7.6 to 91 centimeters in length, and vary in shape, being rounded, bottle-shaped, dish-shaped, club-like, crooked-necked, and coiled. When dried, the shells in the area of study are almost exclusively used as cups, plates, pito mugs, water jugs, and other domestic utensils.

12. One of the advantages of testing for items suspected of fecal contamination for coliform is the use of the membrane filter (MF). The National Training Center of the U.S. Environmental Protection Agency (EPA) has stated:-

1) Results are obtained in approximately 24 hours as compared to 48 to 96 hours for the standard fermentation tube method.

2) Much larger, and hence more representative samples of water can be sampled routinely with membrane filters.

3) Numerical results from membrane filters have much greater precision (reproducibility) than is expected with the fermentation tube method.

4) The equipment and supplies required are not so bulky. A great many samples can be examined with minimum requirements for the laboratory space, equipment and supplies. The filtration step is similar to that for total coliform. The media used for this test is M-FC containing lactose, protein digest vitamins, selective chemicals and aniline dye.

13. It is of interest to note that, as a water pump was commissioned, church, regional government, and other aid donor organizations, moved into some areas to distribute powdered milk. The milk was often rejected after a short trial by the mothers, for being too strong for the babies, resulting in increased occurrence of diarrhea. Subsequent testing showed that since the milk and water were mixed to manufacturers' directions to suit certain age groups, the criticism was without grounds, and after some months of rejection, the scheme was reinstated when the mothers realised the change of water, not the milk, was causing diarrhea. Again, no warning of this probable occurrence was made to the mothers to avoid the risk that they reject the clean water when it became available and return to traditional sources. - Ref: Sisters of the Holy Paraclete Bolgatanga Mission, Upper Region, Ghana, October, 1981.

CHAPTER V

TECHNICAL AND SOCIAL PROBLEMS EVOLVING FROM PIPE-BORNE CLEAN WATER SUPPLY SYSTEMS:

Bolgatanga - Socio-technical Organization:

The town of Bolgatanga is located in the north-eastern section of the Upper Region and is the regional capital, with a social organization not divorced from that of the ambient rural population. This steadily expanding regional administrative center, together with the older district center of Zuarunga, comprises a common urban water-supply area. The population of the Bolgatanga-Zuarunga urban area was 18,896 in the 1970 census. Projection of population growth suggests a 1990 population of about 50,000. It is the nerve center of the region, a service and commodity distribution center, an education and administrative nucleus. Its social organization is based on those economic and political processes.

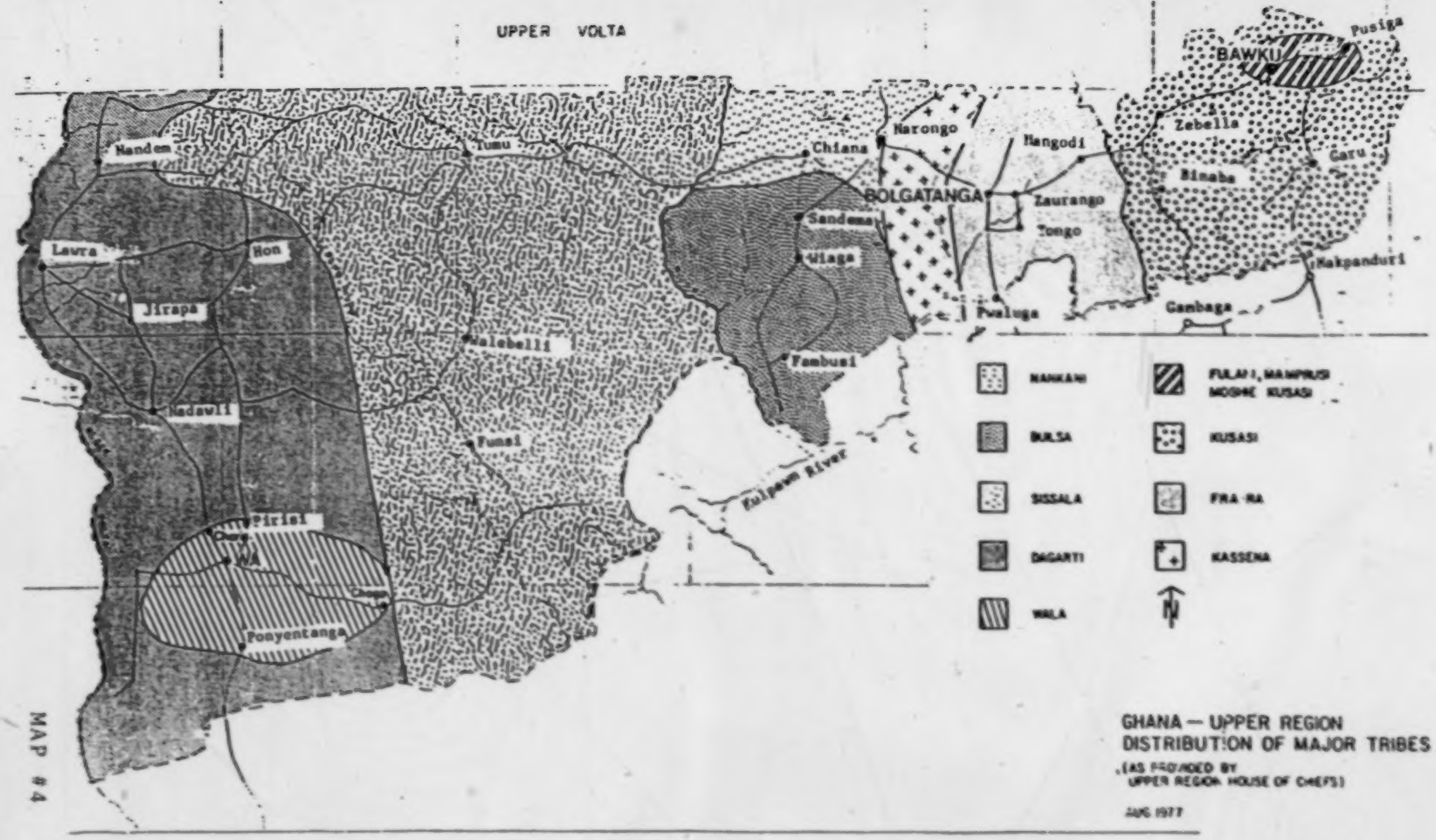
Bolgatanga has no industrial or manufacturing base. It was developed from the time when the administrative center was transferred from Navrongo, a town expanded by the Roman Catholic White Fathers Mission, and located to the northwest, on the route to the north to Ougadougou, capital of Upper Volta. Being a community historically based on administration and commerce, rather than on manufacturing and heavy industry, there is no strongly identifiable labor/capital dialectic. The largest single employer is the government of Ghana, and the majority of the labor force in the town itself is involved in tertiary production: retail marketing and service.

Most of the ambient rural population is involved in a mix of cash and subsistence cropping, while a small but growing number of mainly absentee, wealthy, cash-crop farmers, with heavy agricultural equipment, operate large farms. These are usually wealthy southern Ghanaeans, some civil servants in Bolgatanga, and regional "Big Men". The "Big Men" are sometimes chiefs, while many in the Fulani are known as "Alhij", that is to say, one who has made a pilgrimage to Mecca; and the cultural equivalent of a southern Ghanaean being a "Been-to", that is, one who has been to Europe or North America.

While there is no industrially based class system, there is a considerable inequality of power, property, and prestige in the Bolgatanga social structure. Likewise, as well as differentiation based on occupation, there is also considerable variation based on language and ethnicity.

As shown on Map 4, the Western District of the Upper Region, bordered to the west by Upper Volta and the Black Volta River, is populated by the Dagarti, with a concentration of Wala around their tribal center of Wa. The west-central section of the region, centered around Tumu, is Sissala. To the east of Tumu is a small area with a center at Navrongo, occupied by the Nankani, with the Builsa placed directly south. The area between Navrongo and Bolgatanga is occupied by the Kassena, with the area centered by Bolgatanga-Zaurunga, populated by the Fra Fra. To the east, with the market town of Zebilla as center, is Kusasi country with Bawku within that area, shared by the Mamprusi, Moshie, Kusasi, and the Muslim Fulani.

The majority of civil servants employed in Bolgatanga, however, are Ghanaean southerners, and the dominant language of this elite group is Akan. While there are


UPPER VOLTA
Nandem
Lawra
Hon
Jirapa
Nadawli
Pirisi
WA
Ponyentanga
Tumu
Walebelli
Funsi
Chiana
Narongo
BOLGATANGA
Mangodi
Zaurango
Tongo
Pwaluga
Sandema
Wiaga
Fambusi
Kulpawn River
Zebella
Binaba
Garu
BAWKU
Pusiga
Nakpanduri
Gambaga
NANKANI
BULSA
SISSALA
DAGARTI
WALA
FULANI, MAMPRUSI MOSHIE KUSASI
KUSASI
FRA-FRA
KASSENA
N

GHANA — UPPER REGION
DISTRIBUTION OF MAJOR TRIBES
(AS PROVIDED BY
UPPER REGION HOUSE OF CHIEFS)

AUG 1977

MAP #4

other southerners, such as Ewe and Ga-Adange, and while there is an active movement to fill civil service positions with Upper Region residents, the majority are still Akan. To illiterate farmers and local traders, these southerners are all identified as Asante (Ashanti) regardless of their actual home district. The further one moves away from Bolgatanga into rural areas, the more one sees the police, the civil service and similar services, regardless of whether local or national, as the extension of "White Man's Law", and in spite of twenty-six years of "independence". They are, therefore, alien to the district and culture as much as, and in many cases more so, than the members of the extreme minority white population. The town of Bolgatanga itself is a colorful amalgam of occupations, languages, religions and Christian religious sects, ethnic groups, social status, economic positions and political power bases.

From the viewpoint of productive base, the great majority of residents are independent, poor farmers.[1] Seventy-five to eighty-five percent of the farmers produce no surplus to sell for cash. Major crops, in order of importance, include millet, ground nuts, rice, beans, cotton, and corn. Male and female labor work in the fields.

Farms are not necessarily in composite form, as would be the case in Europe or North America; farmers and their helpers, family or otherwise, may walk several kilometers in a day to work on isolated fields and patches known to be theirs. Property is known to belong to certain individuals, and is in many instances registered in the files of the local House of Chiefs. Yet, there are no deeds to titles to land in existence. All land disputes are settled, either in the House of Chiefs for large land-parcels, as in Bolgatanga, or in courts held regularly around the sacred stool occupied by the local Naba or sub-chief at village level.

Farming is most extensive in the wet season, this being roughly July to September. During the dry season people collect termites, make rope from sissal, trade animals, keep poultry, tend gardens on a small and again fragmented basis, or just do nothing.[2] Farmers keep, in order of frequency, fowls, guinea fowls, sheep, pigs, goats, and cows.[3] Few can afford bullocks[4] for ploughing, or donkeys for transportation, and in some cases, sacrifice.[5] Loans are very difficult to obtain. Livestock is housed in the central portion of the family compound, a circular clay structure comprised of living, cooking and bathing quarters, each with a separate entrance. Compounds are not usually clustered into obvious composite form but rather are scattered unevenly throughout rural areas.

In social organization the majority basis is one of the extended family,[6] with ultimate decision-making power residing with the elders. The Fra Fra culture is patriarchal. Although the Roman Catholic Church is well supported, together with Seventh Day Adventists, Ebenezer Methodists, Baptists, and Anglicans, this support is ninty percent composed of southern Ghanaean families posted to the Upper Region as civil servants. Among the Fra Fra and other indigenous, ethnic groups, traditional religion and beliefs remain strong, along with the continued influence of traditional healers, JuJu men and herbalists.

Village class structure is well-defined. At the top of the hierarch stand the Naba and his elders. In larger villages, teachers, religious and government functionaries, and traders, often form part of the local elite. Rich farmers and traditional healers are also powerful. The majority of people, however, occupy the peasant class which maintains its own internal hierarchy, dominated by older males. While women have no official jurisdiction in the villages, and are required to maintain the compounds, prepare food, care for the children and elderly, work on the farm and garden, and fetch the water, the market women have autonomy to the point that the current, more militant form of government has found it necessary to use armed force to bring about commercial controls and reduce locally inflated price levels.

Many of the women found squatting in the markets of Bolgatanga, Zebilla and Bawku are, in fact, international traders operating in Ghana, Togo, Upper Volta, and the Ivory Coast, and using Twi dialect as an international means of communication. Their means of transportation is buses and trucks which they board with bundles of goods. Previous to the 9:00 p.m.-to-6:00 a.m. curfew, imposed throughout the nation in the summer of 1982, women would walk, complete with baby and a head-portered bundle, through the bush a distance of 40 kilometers to sell the goods in the market and return home the same day.

In general, the people are economically poor though spiritually rich, and the majority are sick. Due to continued stagflation in the national economy, and stringent import-license controls to retain foreign exchange, the market prices have steadily risen; smuggling has intensified in spite of supposedly effective sealing of the nearby borders, thus further reducing the availability of basic items such as nails, string, pins, and pencils. While women from the south retain their mended garments the Fra Fra women, who have been persuaded by example and pressure from church health-clinic staff to dress, must squabble at the market place in a pile of what viewers from developed countries would describe as "industrial rags". Here, they must select torn and holed garments with which to provide a western view of modesty in their attire, while losing their slender dignity and ebony poise with ill-fitting, holed and tattered rags, purchased at excessive prices.

In Bolgatanga is situated a modern hospital with equipment and laboratories. A southern Ghanaean staff attempts to cope with the influx of truly sick people and those who, except for the lack of simple items such as aspirin and vasoline, could easily be cared for in their homes. The hospital is equipped with sixty-two modern hospital beds but spaced between these are piles of rags on which are placed patients who are financially and influentially less fortunate. Bulk-produced native food from the kitchen is available to those who can pay, but most have food brought into the hospital which is at all times crowded with visitors. A grassed area opposite the hospital provides space for food vendors to satisfy the requirements of patients and visitors alike, and for visitors to prepare food for their sick relatives and to camp out if they lack relatives living in Bolgatanga. There are no hotels or resthouses now open. The work of this hospital is fortunately supplemented by way of prenatal and post-natal, and general health clinics, operated by White Sisters of various Christian churches in Bolgatanga. The posts are in general mud huts with all equipment brought in by pickup or motorcycle by the staff on appointed days, as for the Zoko Child Welfare Mobile Clinic and Bongo Health Post, together with others in the Bawku area.

Technical Problems with the Urban Pipe-Borne Water Supply:

At the initiation of the Upper Region water project, in 1974, the water supply for this area was drawn from a bore-hole field of eleven wells located to the north-east of the town. The Zuarunga area was supplied from a separate bore-hole field of four wells. Only the water from the small, surface water-storage pond was treated. Bore-hole supplies from Bolgatanga were pumped directly into a ground-level reservoir of 80,000-Imperial gallon capacity. The well field mains supplying Bolgatanga and Zuarunga were interconnected, but normally separated by closure of the main sluice valve.

The existing ground water-supply was considered as inadequate to meet growing demands and, therefore, GWSC initiated the development of the current new supply surface-water sources from the irrigation reservoir on the Horongo River separating Vea and Gowri villages. The reservoir is located seven miles north of Bolgatanga, as shown on the area map, and was built to provide irrigation for an area of some 3,500 acres in a project completed in 1978. The completion of the irrigation project was delayed for two years due to the usual lack and subsequent delay in funding.

In adopting the change from a ground-water source to surface supply it was necessary to provide for full treatment of raw water supplied from the Vea Dam.

A separate off-take was installed consisting of a 16-inch diameter steel pipe terminating at the downstream face of the dam, with a sluice valve.

The project involved the construction of a raw-water, low-lift pumping station at Vea Dam and supplied directly by a 15-inch main, some 13,200 feet in length, to a treatment plant located near the junction of the Vea-Yorongo road.

The treatment plant was expected to comprise:-

- chemical treatment
- sediment tanks
- settled water well
- pumping station and ancillaries
- pressure filters
- lagoon and waste water recovery tanks.

From the treatment plant, water would be conveyed in a 12-inch high-pressure main, some 23,700 feet, to a 600,000 Imperial gallon storage reservoir to be constructed at the highest convenient location in Bolgatanga. The object was to provide all year-round clean water supplies sufficient to cater to the growth of the Bolgatanga-Zuarunga demands up the the year 2000.

The project was built somewhat behind schedule which increased costs as the Ghana cedi was devalued. Workshops were completed in Zauranga as late as November, 1982; the GWSC Headquarters was completed in the yards of GWSC at the highest point in Bolgatanga and an additional 300,000 Imperial gallon high-level tank (HLT) was constructed alongside the existing 10,000 Imperial gallon tank built prior to Independence in 1957. The 600,000 Imperial gallon storage reservoir proposed was reduced to the 300,000 Imperial gallon HLT mentioned (Diagram 1), and the 12-inch line was installed between the Bolgatanga.[7] The 16-inch line remained in the Vea Dam as specified, but the pipe from it to the Gowrie low-lift pumping station remained at 8 inches in the political[8] process of restricting a maximum 1.3 million Imperial gallons per day off-take of from the primary agricultural-irrigation purpose of the Vea Dam.

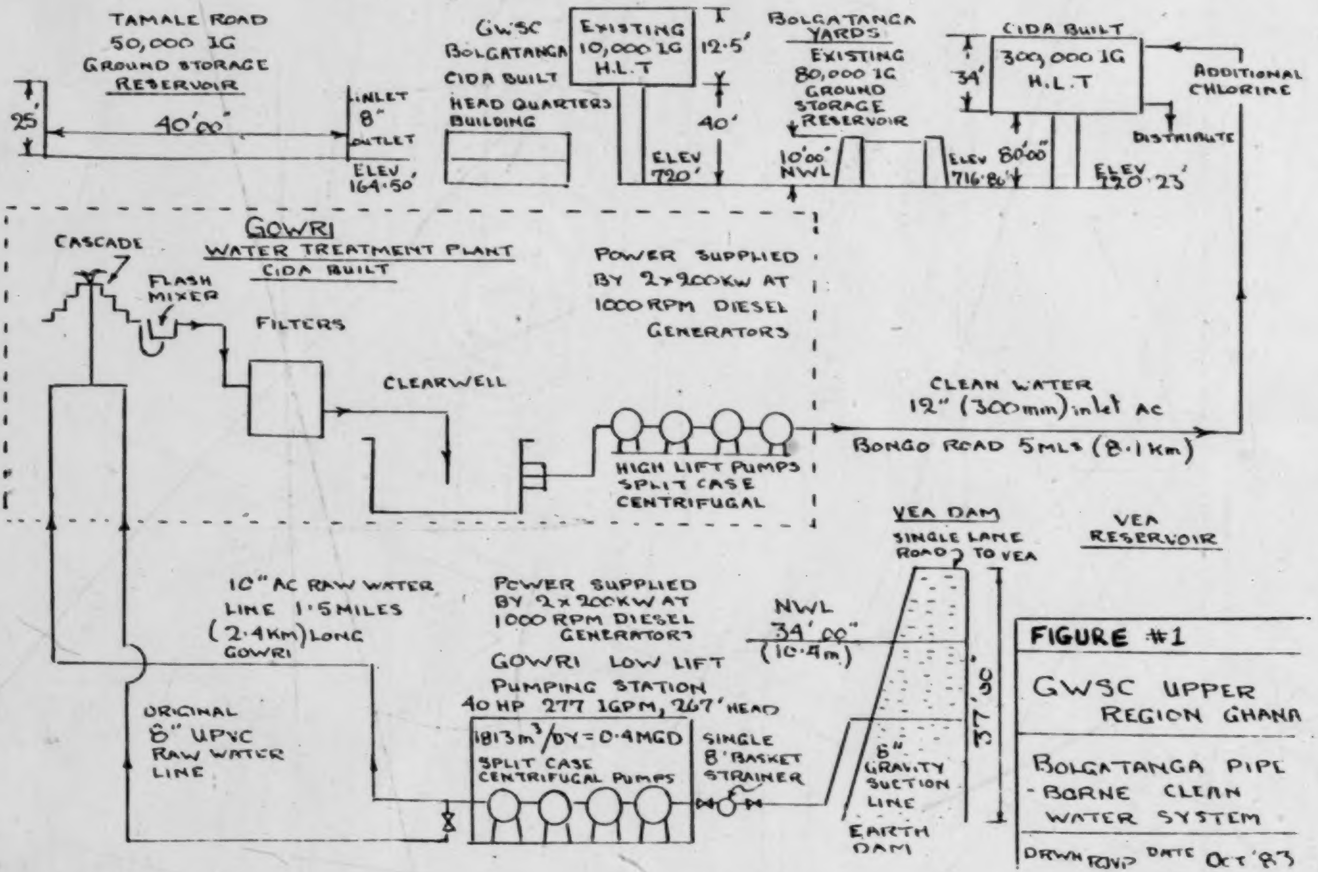

TAMALE ROAD
50,000 IG
GROUND STORAGE
RESERVOIR
25'
40'00"
INLET
8"
OUTLET
ELEV
164·50'
GWSC
BOLGATANGA
CIDA BUILT
HEAD QUARTERS
BUILDING
EXISTING
10,000 IG
H.L.T
12·5'
40'
ELEV
720'
BOLGATANGA
YARDS
EXISTING
80,000 IG
GROUND
STORAGE
RESERVOIR
10'00"
NWL
ELEV 716·86'
8'00"
CIDA BUILT
300,000 IG
H.L.T
34'
ELEV
720·23'
ADDITIONAL
CHLORINE
DISTRIBUTE
GOWRI
WATER TREATMENT PLANT
CIDA BUILT
CASCADE
FLASH
MIXER
FILTERS
CLEARWELL
POWER SUPPLIED
BY 2×200KW AT
1000 RPM DIESEL
GENERATORS
HIGH LIFT PUMPS
SPLIT CASE
CENTRIFUGAL
CLEAN WATER
12" (300mm) inlet AC
BONGO ROAD 5MLS (8·1Km)
VEA DAM
SINGLE LANE
ROAD TO VEA
VEA
RESERVOIR
10" AC RAW WATER
LINE 1·5MILES
(2·4Km) LONG
GOWRI
ORIGINAL
8" UPVC
RAW WATER
LINE
POWER SUPPLIED
BY 2×200KW AT
1000 RPM DIESEL
GENERATORS
GOWRI LOW LIFT
PUMPING STATION
40 HP 277 IGPM, 267' HEAD
1813m³/DY = 0·4MGD
SPLIT CASE
CENTRIFUGAL PUMPS
SINGLE
8' BASKET
STRAINER
NWL
34'00"
(10·4m)
37'00"
8"
GRAVITY
SUCTION
LINE
EARTH
DAM

FIGURE #1

GWSC UPPER
REGION GHANA

BOLGATANGA PIPE
-BORNE CLEAN
WATER SYSTEM

DRWN RDVP DATE OCT '83

Problems of Suction-Strangulation at Gowrie Low-lift Pump Station:

While the suction manifold of the existing split-case centrifugal pumps remained at 8", the pumps had never before been called upon to deliver the full off-take. This factor brought three obvious and fundamental system-design problems into focus at the October, 1981, commissioning. These immediately threatened to cut off or severely restrict supplies of clean water which the urban areas of Bolgatanga relied upon due to the steady decline of output capacity of the 1939 vintage pumping station on the Tamale Road. The problems were;

a) suction line too small

b) absence of duplex suction strainers

c) suction line in the dam face incorrectly positioned.

A. While the suction of the pumps was retained at 8", the discharge line traversing the 2.4Km to the Gowrie Treatment plant was 12" as specified and in fact necessary to achieve the 1.2 mg/day accepted as the capacity of the whole system. Therefore, the pump suction (8") was smaller than the required discharge.

B. On water systems of this type there is installed a duplex suction strainer; that is to say, there are two strainers and the piping and valves arranged to change over to one filter while the other can safely be removed for cleaning by releasing a series of hand clamps and washing the basket strainer.

Not only does the Gowri system retain the single 8" basket strainer with no bypass, but access to the filter basket is by way of a heavy plate secured by 10 large bolts for which no tools were supplied and no spare bolts, nuts or washers were on hand to ensure the plate was always secured to avoid the ingress of air to the pump suction. Since the basket strainer became plugged with shells, sand, fine gravel, and dead fish every 15 to 30 minutes, the staff of the water treatment plant 2.4Km distant were required to watch the intake level of the wet wells to avoid lowering the filter levels when the water ceased to flow in from the low-lift station due to a blocked filter. No telephone or radio communication had been arranged between the two plants. To communicate, someone must walk from the treatment plant to the pumping station, a distance of 2.4 Km, to establish the nature of the loss of water flow.

When the single strainer became blocked, the plate was removed by unbolting the cover plate and the basket filter tapped out since there were no facilities to waterwash the strainer.[9] In a very short time the single basket became damaged allowing foreign matter to enter the pumps and piping.

C. Problems of Sluice Valve Positioning at the Vea Dam:

The reason for the frequent blockage of the strainer was the position of the water inlet in the dam. The sluice in the dam, built solely for the purpose of irrigation, was arranged in the dam face at the center and water poured into concrete channels directing it into stone-lined channels for distribution into the fields. If the sluice passed sand, fish and other foreign matter, there were no small bore pipes to block. Since a constant flow of water from the Yaronga River caused scar and deposition around the natural slopes of the reservoir, the dam area was a primary deposition area. It was therefore fundamentally one of the positions around the reservoir that 8" water-system suction lines should not be placed. A scar area some 50' (15m) away on the east or Gowri side of the reservoir would have made an ideal suction intake for the system with a 16" pipeline run under the dam top access road to the low-lift pumping station.

Catchment Basin, or Suction Wet Well:

Even if cost was a factor in providing fundamental and appropriately correct facilities, it is difficult to understand why CIDA would allow a contractor to directly couple an obviously undersized system suction intake to an equally undersized system water-pump manifold. A Catchment basin, or suction wet well, could have been constructed beside and below the low-lift station, close by the existing irrigation water channels and, therefore, well below the water level in the reservoir. The water would flow by 16" gravity line into the reinforced concrete-lined suction wet well, with a level control valve in the line. In place of the restricting 8" pump suction manifold, all four pumps would have individual 8" suction lines running horizontally direct into the suction wet well.

This method would avoid the present suction strangulation for the last pump on the manifold.[10] Suction strainers would then become an optional extra and the system would then become trouble-free, providing the approximately 6m x 3m x 3m suction wet well was also equipped with a sediment drain valve beneath the concrete floor slab.

The system, as designed and commissioned for CIDA, quickly failed, and the costly Gowri low-lift pumping station was placed out-of-action only two months after commissioning, and remains so some two years after.

It was significant, and a coincidental face-saving to CIDA that the coup d'etat by the AFRC party, lead by Flt.Lt. Gerry Rawlings, coincided with this breakdown. The GWSC Regional Manager was immediately suspected of sabotage and armed guards watched on a 24-hour basis while a trench was dug to bypass the offending station, and a pipe-line laid to connect into the raw-water line beyond the station. A mobile diesel pumping unit was then connected into the system and water was drawn from the nearest concrete channels of the irrigation system. The enforced emergency rectification of a CIDA design-omission remains in place in January, 1984, to maintain rural supply system until a design, an approval, and funding, are provided to complete the sound operation of the CIDA-supplied urban water-supply to Bolgatanga, as initiated in 1974.

The Selection of Appropriate Diesel Electric Power Plants:

Electricity supply in Ghana is primarily the responsibility of the Electricity Corporation of Ghana (ECG), a state corporation. Apart from the major hydro-electric plant discussed in Chapter I, major towns such as Bolgatanga are equipped with diesel generators of the 1000 to 2000 kilowatt, 50Hz, 514 RPM, slow-speed type, mainly supplied in around 1960 to 1970 by the British companies, Mirrlees, now of the Hawker Siddely Group, and English Electric, of the GEC Group. In the Upper and Northern Regions, engines are operating only by way of supplies of spare parts, and factory technical assistance provided by CIDA grants. Even so, due to the shortage of fuel oil supplied by an occasional road tank arriving from Tema on the Guinea Coast, power supplies are intermittent and selective by area. With the shortage of fuel oil, and low load-bearing power station capacity, there is no point in extending power transmission lines towards rural areas even if funding was offered by CIDA, some other donor nation, or institution.

In 1981, therefore, CIDA approved the purchase by GWSC of two, 200-killowatt, 1000 RPM, naturally-aspirated, radiator-cooled, diesel generating sets, to power the Gowri water treatment plant. Two identical sets were purchased to power the Gowri low-lift pumping station, and a further three, 100-kilowatt sets of the same GEC-Dorman "Q" range, to power the low-lift pumps at Bawku.

To purchase these sets, CIDA issued, by way of W.L. Wardrop and Associates, the standard questionnaire, which served as a specification to suppliers. While this form of specification is undoubtedly the most democratic possible, it does little to convey the precise criterion necessary to obtain technology appropriate to a given site or geographic area. Neither does it encourage the offering of alternative specifications from suppliers with a greater knowledge of appropriate equipment than the consulting engineers. The specification issued in a questionnaire form actually constitutes an embarrassment to both consultant and supplier unless, as fortunately was and remains the case here, the firm of consultants is prepared to listen and openly discuss alternative suggestions to provide the most ideal specification for the site at the lowest price. Further, the consultant must insist, with CIDA officials, that regardless of the limits of funds belatedly made available for this specific part of the project, the level of simplicity matched with quality, must not be undermined by a bureaucratic refusal to fund beyond a pre-stated limit set many months earlier at price levels since affected by inflation. Canadian content levels, set at 66-2/3% expectancy, should likewise bring about the selection of any other equipment than that selected by what was in fact a brilliant example of cybernetic negotiation.

Therefore, the following criteria should apply to diesel generating sets in the 100KW-to-600KW range, and all similar tropical regions where spare parts and manufacturer representation is not available in that country or region:-

A. ASPIRATION: The engines should be, ideally, naturally aspirated to avoid failure by the breakdown and lack-of-service availability of turbochargers. However, recognizing that such engines are now rarely available on the market due to their relatively high cost per kilowatt, a turbocharged engine may be selected if the turbocharger is protected by an air-to-air charge air intercooler, integral with the cooling water radiator.

Turbochargers of the floating, bush type, are particularly susceptible to the ingress of sharp sand, damaging those bushes and slowing the rotor. This in turn subjects the exhaust turbine blades to excessive heat as the engine draws fuel on consequential overload.

Alternatively, if the intercooler is, as is often the case, externally water-cooled, the variation in water temperature, or the shortage of water, will increase the air temperature to the cylinders and cause the piston to seize in a very short time.

Therefore, if turbochargers must be employed, then the engine rating should be selected to cover an engine equipped with air-to-air charge air cooling, and which are usually designated with a non-clemature ending in CA.

B. COOLING: The engines should be radiator-cooled and, regardless of the mean ambient temperature of the site, the radiator should be rated for a minimum ambient temperature capacity of 125°F. (52°C.). The reason being that, while the jacket-water circuit of the engine is closed, there will be a frequent need to top-up the radiator. If the operators are not concerned about the standards of water they consume, they will be even less concerned that the engine receives the clean water it requires to avoid the ingress of sand, causing a reduction of cooling-jacket capacity and a lowering in the efficiency of the water pump as the impellor is rapidly eroded by sharp sand in suspension.

C. RADIATOR CAPS: Radiator caps should always be chained to the radiator headers to encourage replacement after filling, since all modern engines are equipped with pressurized cooling-water systems to increase cooling capacity, and to reduce liner and cylinder-block sidewall attack by impingement of entrained oxygen bubbles.

D. WATER TREATMENT: Water treatment of the tannin-based, inhibitor-type, must also be added to the coolant of the engine to maintain the pH of the coolant at about 8.4 to counteract the extreme acidity or alkalinity frequently present in untreated water. The engine can corrode or erode at a rapid rate if this factor is not adhered to.

The ideal method of cooling engines in tropical regions is by air-cooling where no water whatsoever is required, simply an arrangement of hot-air discharge ducting out of the building or the engine area, to avoid discharged hot-air recirculation to the cooling-air intake. This type of engine, however, should be restricted to maximum 60Kw at 1500rpm, due to the counter-productive complexities of vee-engine ducting at higher ratings. It must be emphasized that proper installation is the key to success in air-cooled engine operation.

Starting:

Hand Starting, using a crank hand, is a commonly employed method in all parts of Ghana on small single and two-cylinder air-cooled and water-cooled engines installed as power generating sets, belt-driven sawmills, together with rice and grain mills. The engines are 15BHP at 1500rpm and are fitted with cylinder-decompression equipment. The crank handle should be fitted to the full-speed shaft, that is to say, the crank-shaft to crank the engine over at 70RPM minimum, to enable one cylinder to fire on compression ignition and for the engine to continue up to sustaining speed at a minimum of 90RPM. Cranking any engine is an art lost some thirty years ago in developed nations but remains common in developing countries.

However, it is unrealistic to expect operators, suffering from some form of illness, dehydration and mal-nutrition, to succeed in hand-starting a diesel engine about 15BHP, or with more than two cylinders. For engines above 15BHP, or with three cylinders, as are presently proposed for the maintenance and stabilization phase of these programs, electric starting should be the primary means of starting with the facility for hand-starting as a back-up feature.

Air Starting:

On engines driving up to 600KW generating sets, air starting by air-start motor is inappropriate in humid and sandy environments for five basic reasons:

i) The wire air filters, which must be fitted to the air-start motors, become quickly blocked with sand and will not allow the vane-type motor to turn. The engine then either becomes inoperative, or the air filter is removed, causing vanes to wear rapidly by ingress of sand.

ii) The same condition applies to the required air compressor, except that the aluminum piston becomes scored and seizes, cutting off all necessary 120 psig starting air.

iii) On the same compressor set the air receiver readily accepts humidity from the air, acting as a condenser from the hot compressed air, and rapidly fills the 11.25 cubic foot air receiver with condensate. This must be drained each day during wet seasons to avoid water replacing starting air, not only reducing the capacity to start the engine, but also circulating water and particles of oxidization into the air-start motor or its filter.

iv) The vanes on the air motor contract line corrosion when the starter is not in operation and the motor seizes, requiring skilled labor to rectify.

v) The air-motor lubricator reservoir is neglected and the starter motor again seizes.

Electric Starting is, therefore, not the ideal, but the most appropriate method of starting engines of this size. The major problem is the lead-acid battery. Serviceable batteries are rare, like all other commodities in Ghana, and likewise the essential sulphuric acid/water electrolyte. In addition, perhaps due to the perpetuation of British training, Ghanaean mechanics fill batteries with 1.265 specific-gravity electrolyte suitable for temperate countries such as Britain, whereas electrolyte with a specific gravity of 1.220 should be used in tropical countries, with a specific gravity of 1.250 as an ideal for the Upper Region. With the combination of electrolyte too strong, and the 30 amp. 125°F. boost-charge employed by local mechanics and electricians, rather than the recommended 5 amp trickle charge, many batteries are dead before they are out of their packing cases. However, this type of problem can be controlled by specifying the correct specific gravity of electrolyte and by effective instruction of battery-servicing personnel.

Engine and Alternator Air Filtration:

Two of the most serious omissions of the CIDA-approach specification was the need for appropriate air filters for both engine and alternator. The standard air filter fitted to this size of engine, more especially the paper cartridge and oil-bath type, are totally unsuitable for environments such as the Upper Region,where both coarse and fine sand are in suspension. Such filters become blocked frequently during the dry Harmattan season with damage to the engine resulting due to oiling of cylinders, overload and piston seizure. Heavy-duty cyclone-type filters are essential, and though they also are equipped with paper filters as a secondary filter medium, in practise it has been found that; providing sand is removed daily by way of a neophrene finger-squeeze nipple beneath the filter body, the paper secondary filter rarely requires changing. Such filters are readily available in Canada, being a standard heavy automotive commodity.

Alternators must be fitted with screen filters on both air inlet and outlet ends. These filters must be of a type which clip into place by hand and are washed with water only, then briefly dried in the sun. The screens are attached to the alternator body by way of stub-ducting for ease of attachment.

A screen filter is placed on the air inlet of the alternator to filter out sand which, mixed with lubricating oil vapor deposit, will effectively plug the air gap between rotor and stator windings which is approximately 0.085". In addition, the presence of sharp sand will abrade the insulation from both windings, causing a short circuit and failure of electric power.

The alternator air-discharge screen is required to prevent the ingress of sand into a stationary generating set during the sand storms of the Harmattan and, given the premise that all power-plant buildings will be constructed in traditional manner with one side open, i.e., with bird-screen panels only, or will operate with a large open door to maintain an all-year reasonable working ambient temperature.

Excessive Circuitry:

Wherever possible, all power-station switches, regardless of function, should be included in the diesel generator supplier's panel. Standard practise is to make both circuits totally separate, simply because the electrical section of the consultants attends to the requirements of the generating sets, while the civil engineers are concerned with buildings. Cost-saving and simplicity of design and maintenance, coupled with equipment security, requires that electrical wiring and accessories should be rationalized and coordinated.

Control-Panel Locks:

Generating set control panels are in general specified in CIDA and general specifications as requiring brand-named high-quality chromed automotive-type handles and locks for purposes of security and appearance. In developing countries, including the area of study, such handles are unacceptable. The panels, being tropicalized, have a dead front, that is to say, there is nothing alive electrically on the front door of the panel; it merely serves as security against unauthorized tampering and climatic elements. To start or stop a generating set, or to ascertain its correct function, it is therefore required that the front door must be unlocked. In the

Upper Region, as elsewhere in developing countries, locks, and therefore keys, are a rarity. Whoever is given charge of the keys to the control panels must care for them against theft much more so than in developed countries. Furthermore, to hold important keys is a status-symbol to be guarded. For these two reasons, and the complete absence of telephones in the area, the keys will not be readily available. Breaking into flush-mounted doors would destroy the panel. It is therefore essential that the front door of the panel is secured with a simple hasp and staple fitted with a padlock. If the keys are not made available by the individual responsible for them, or they are lost, the padlock can be sawed off and easily replaced with a minimum of inconvenience to the essential operation of the power plant and the water-supply equipment and, therefore, the community of people it serves.

Fuel Tanks:

The ideal arrangement of fuel tanks is an assembly of single or coupled 250IG (1125 liters) standard fire underwriter's-approved tanks to suit the fuel consumption and power house configuration. All tanks should be coupled and complete with level gauges, isolating valves, drain valves and coalessor filters. The assembly must include a semi-rotory fuel-transfer pump, and an electric motor-driven transfer pump with level switch or both. The pumps are required to transfer fuel from a large permanent fuel tank into the engine fuel day tank assembly described here but, due to current long-term fuel shortages, facilities must be provided to hand-pump the fuel out of a road tanker or 45IG (200-liter) drum, together with a sufficiently large filler-cap to facilitate filling by bucket or calabash.

Summary:

The foregoing factors may appear to have no bearing on the sociological features of community development, as characterized in developed countries where electric power-supply is taken for granted and the problems associated with that supply are the concern of another discipline or authority. In the area of study and similar developing environments dependent upon pipe-borne clean water for health, the source of power is vital. Without a reliable source of electric power, all equipment associated with the water supply ceases to function and every member of the community must immediately resort to traditional disease-ridden water sources, always assuming that they are still available. If one hand-pump fails, another pump is available within reasonable walking distance. If pipe-borne supplies fail, there is rarely an alternative clean water-source available, more especially with sufficient capacity to cater to the more dense urban population. In addition, the homostatic balance of the urban community is upset and violent internecine disputes will occur as a result of the stress experienced from increased hunger, thirst and sickness, as is a regular occurrence in Tamale, to the south of Bolgatanga.

CHAPTER V

FOOTNOTES

1. Koskamp, H., & Schatz, R.J. (1976)
   Agricultural Extension Evaluation Survey
   Bongo Agricultural Station

2. Jackson, Ted (1978)
   Health, Water & Adult Learning Strategies for Upper Region, Ghana
   Department of Adult Education, Ontario
   Institute for Studies in Education
   Toronto, Canada

3. In Fra Fra social organization, cows are rarely slaughtered; if they die the carcass is burned; in some cases because it died by a curse or by the presence of an evil spirit within it. Otherwise, cattle are kept for breeding and for marriage dowry, either for the immediate family, or by sale to other persons. The size of a cattle herd is a direct indication of the affluence of the owner.

4. Many farming families possessed bullocks in early years of prosperity, now there are many yokes, ploughs, and associated equipment lying in fields - the bullocks to draw them, long ago dead or sold. The Anglican Church in England is presently supporting the revival of bullocks to use for ploughing and cart haulage by way of their "Church Village" program, centered at the Sisters of the Holy Paraclete Anglican Mission, St. Cyprian's Church, Bolgatanga, Upper Region.

5. Fra Fra sacrifice donkeys to animist spirits and eat them at feasts; the Dogarti from the west sacrifice and eat dogs, and are therefore subject to jocular derision.

6. The extended family may include not only parents and other elderly relatives, but also creditor son-in-laws. In Fra Fra tradition, if a boy wants to marry a girl, he arranges for four of his friends to capture her and take her to his home. He then meets with the father of the girl taking a gift with him. He informs the father of his intentions to marry the daughter. They then agree to a dowry, usually as high as four cows. The boy then lives with the girl in her compound. If the dowry has not been

paid over the years then the father demands the return of the daughter, however, by this time the daughter has probably produced one or two children and the father is obliged to accommodate and otherwise support a likely rebellious daughter and her probationary husband. Also, in this traditionalist form of marriage, divorce is simply a matter of sending the girl out of the compound. She is generally then rejected also by the family because she can not be "recycled" too readily due to her civil status not being clear. If a dowry has been given, the rejection by the husband is much more difficult and may be subject to the judgment of the local Naba and his advisors. Any couple that marries into Islam or Christianity is then subject to civic court judgment on a divorce.

7. - In 1981 the Naba of Gowri demanded by deputation to the Regional Manager GWSC in Bolgatanga that since the CIDA-built treatment plant had been built on land purchased from him, it should be named "Gowri Treatment Plant", in lieu of Bolgatanga Treatment Plant, even though none of the residents of Gowri could officially gain access to the pipe-borne chlorinated clean water supply destined for the people of Bolgatanga 8.1 Km distant. His people and his palace household enjoyed hand-pump supplied water, regarded as much sweeter than the tasteless product of the treatment plant. Reference shown in the original specification to the Vea low-lift pumping station also changed similarly to Gowri since the village of Vea is located on the opposite side of the Vea Reservoir. The two belated posted name changes were further offending examples of the lack of grass-roots interaction at the early stages of this project.

8. - Since the FraFra are predominantly millet farmers and cattle herders, the supply of farm land irrigation was of prime importance idealistically. In actuality, the lack of available water in the Yorongo River, feeding the Vea Dam, was so low that planting millet on a large scale would have resulted in a waste of planting energy.

9. - The CIDA-approved design omitted a filter water-wash tap because it was feared pumping station operators and passing pedestrians might drink the raw water from the tap. The water came from the reservoir which the villages readily used for drinking, washing cloths, utensils and bathing. It was simple, the

principle that no one must be tempted to drink surface water once ground water and pipe-borne water was available. The only alternative means of cleaning by 100 psig air by way of a small compressor was not provided in the program, neither has it been provided in programs instituted since November, 1981.

10. - The fact that the 16" suction intake remains in a deposition area, together with the recent lowering of surface water flow rates, requires additional modification of the dam face sluice valve.

The 16" intake must be lowered to a level close to the natural level of the reservoir, and an elbow fitted to raise the intake vertically to a series of four sluice valves. This will allow the the highest submerged valve to be employed at a given water level and therefore avoid picking up sand in suspension. At the same time, as the water level drops, there will always be a sluice valve open for water intake. Access to valves should ideally be made by concrete tower, but may more readily be by external steel ladder attached to the vertical pipe.

Care must be taken for the intake to slope down into the suction wet well to drain all ingressed sand, and other foreign matter, into the well for removal and thereby avoid blockage, as would be the case if horizontal 16" pipes, or concrete galleries were constructed for this purpose.

CHAPTER VI

Sociological Conclusions:

The responsibility of CIDA, if judged only from the viewpoint of omissions, in the provision of infrastructure for the obvious conditions to be met and, as has been discussed here, it would seem that CIDA officials, the Treasury Department, and involved politicians alike, have displayed a remarkable lack of knowledge of social and economic conditions that are common in many African countries. The preblems discussed here are by no means the result of social tradition and behaviors found exclusively in the Upper Region of Ghana. For the non-academic reader of this study it may seem common-sense that the CIDA Water Utilization Program staff should have been at work immediately upon the commissioning of the first hand-pump, thereby bringing to light the need for: training of pump mechanics, forming water-management committees; extended concrete aprons, animal troughs, run-off gardens; sanitary hygiene near the pump; together with the paradoxical problem that cleaning calabashes in the obvious way actually makes them dirtier.

Even the non-technical reader may consider that using a single, eight-inch basket strainer would be inadequate to pass pressure pipeline water supplies to a twelve-inch town water-system. The suction should surely not be placed in a reservoir where it is subject to frequent blockage by natural deposit of silt, shells and dead fish. Furthermore, this same suction filter can not be cleaned by operators because the access plate is bolted down and no tools are made available, and no provision for communications to call for assistance as required.

The average Canadian taxpayer may concur that having accepted the intention to fund the project, we would do well to first correct our errors in the recipient country. Then, subsequent steps would be taken to ensure these errors and mounting expenditures are brought under control in Canada at the earliest convenience of the responsible Federal Government officers.

However, while programs are changed and new programs initiated, with few exceptions, the overriding mentality among government officials and consultants alike is not to tackle the existing problems with sound well-discussed solutions, but to seek funding for yet another program which hopefully may cure the previous omissions in due process.

To challenge or to question a long-term basis, this apparent head-in-the-sand policy, taxes the tenacity, energies and enterprise of any individual concerned with the delivery of appropriate technology, whether in respect to the rectification of stalled previous programs, or in efforts to avoid further errors in equipment selection being committed on current programs. Improvements are made, minor policies are adjusted, suggestions on minor, though significant, selection of equipment receive a hearing, but are adopted only if they fit into the current program awaiting budgetary approval. No discussion takes place on the life-and-death ramifications of misjudged priorities or the status of the overall image of Canadian technology and its inherent culturally matching characteristics. There seems to be no room for interdisciplinary discussion which must essentially mix logic of economics, administrative procedures and technology for a common end.

As may be readily seen, the overall approach to both the bore hole/hand-pump project and the pipe-borne project was in fact one of program mentality. The responsibility for the successes, rectifications, failures, inadequacies, and omissions evident in both programs, lies equally with the various CIDA officials involved over the years and with those consultants and cooperants. The representative of the donor nation, whatever capacity he or she may be dispatched to fulfill, is the ultimate conveyor of policy. Theoretically, the representatives' approach should always be one of concern for the long and short-term benefit of the people of the recipient nation, addressed as individuals rather than groups. How the representative assesses the assignment, plans the program, establishes the short and long-term priorities involved in the program, and how well the current cybernetic approach is established with the recipient people, are factors directly instrumental in determining how well the job is done, both in the view of donor and recipient alike.

The state of programs initiated which were continued, but for the most part were left incomplete, in error or prone to failure, can only be described as mismanagement of Canadian public funds by CIDA due to insufficient preliminary study by CIDA-employed and CIDA-contracted specialists, of the socio-technological problems at the grass-roots level. Such problems could have been detailed in the specifications issued democratically to interested consultant-contracts to allow them to ensure the provision of sufficient CIDA infrastructural programs were initiated to support and complement their portion of the clean water supply program. This was more especially important since the consultant-contractor was as usual appointed at Federal Government ministerial level and therefore not necessarily on the basis of past experience and success in water supply provision in a developing country..

The project was therefore initiated with CIDA social support services not in place; no policy of cybernetic form of participatory democracy by recipient villagers; no feed-back to the consultant-contractor appointed, as to the results of CIDA-initiated socio-technical studies on the state progress towards return to health of the recipient villagers.

The inexperienced consultant-contractor was therefore allowed to approach the project with the erroneous though wide-spread ethnocentric premise that techniques, programs and forms of equipment and construction that have worked well in most developed countries will work equally well in developing countries.

Even when the CIDA Water Utilization Program team was in place with a Canadian manager, there was no direct official liaison between the Canadian water supply construction team and the WUP team. Both managers liased with the Regional or District Managers of the Ghana Water & Sewage Corporation, but never with each other.

As a consequence, in the Upper Region projects as opposed to the CIDA-sponsored NORRIP program centered around Tamale in the Northern Region of Ghana, there is no official recognition of the better assumption that: village water supply recipients are anxious to improve their living conditions and will modify their social behavior if technical and health practise innovation is presented to them in such a manner that they perceive advantages. This is always on the premise that the social cost in the form of disruption of religious beliefs and traditional and valued ways is found to be reasonable.

While there is some form of cybernetic structure in place, it is in reality the continued liaison between the representatives of the Canadian consultant-contractor and the Regional Manager of GWSC. There is no involvement of even the leaders of the recipient villagers. Some tokenism is paid to the recipients by having the Regional Manager sign all purchase orders for equipment, which assumes that he has with full cognizance approved the equipment selection and recognizes the appropriateness of that equipment proposed by the representatives of the consultant-contractor. He is in fact confirming on behalf of the water consumers affected that the innovations proposed by the consultant-contractor, and approved by CIDA officials, will in fact represent functional improvements.

Likewise, those improvements will be tailored and modified to conform, and indeed match as near as possible, local cultural expectations, and climatic and physical conditions. He is also, in signing, convinced that when the GWSC (Ghana Water and Sewage Corporation) takes over the control and operation of that equipment, it will continue to function as was intended, for a long, trouble-free period, with a minimum of maintenance, which the prevailing national economic and political constraints, together with the lack of local skills will, by necessity, bring about.

Looking at these serious short-comings and deficiencies of the past, and the continued lack of real turn-around in problem solving, there must be some resolution if the Canadian government intends to maintain a presence based on health through clean water supply in the Upper Region.

There appears to be two fundamental sociological problems serving as barriers to all development stages of this project: One, manifest by CIDA-approved specialists; the other, the fatalistic stance of Ghanaean supervisory personnel from the South, and the indigenous clean water supply consumer/recipients. These are all bound to a third problem, this being the complete absence, or unqualified implementation, of a cybernetic approach to the goal of the project which was to bring health to the communities of the Upper Region.

1) The Problem of Program Mentality in a Make-and-Mend Society: Since the dissipation of colonialism and empires, specialists from industrialized developed countries are trained in a manner which will equip the individual to function skillfully and knowledgeably in that particular country. The specialist, whether medical, technical, educational, financial, administrative, or agricultural, is concerned with the maintenance and innovative learning levels required to cope with problem-solving and development found in the level and maturity of the culture existing in that country at the time training takes place. He or she must address these problems of maintenance and development in the manner prescribed at the time of training.

In Europe and North America, immediately following the second world war, the prescription was almost universal for the individual to learn systematically and, equally by job practise and theory, over a period of not less than 10 years, the field of specialization from fundamental principles and practise up to the learning and application of advanced theories. With the destruction by trade unions of bound apprenticeship and similar "sandwich" training, the trend by necessity swung to a reliance on theory training, student apprenticeships, and laboratory practise. The early approach required a direct and knowledgeable approach by the shortest route to the problem, the program stage was subsequent and involved a means to avoid the re-occurrence of the problem. The specialist was therefore problem-oriented from the earliest days of junior training or apprenticeship in, for instance, washing clothes or utensils at a water source, rather than waste time and their sometimes sparce energy in carrying the water to complete the same operation in a distant, space-restricted and undrained compound.

It is not acceptable to state that providing the minimum-sized concrete pad encourages village self-help groups to extend the CIDA-supplied base into a large, drained working area because, without reinforcing bar extensions from the central pad, any additional concrete structure will in due course separate from the central pad and encourage the ingress of waste water under the pad into the borehole and create a further source for mosquito breeding and unpleasant odor.

Self-help projects of this kind were encouraged by Wardrop and Associates staff, on behalf of CIDA, as a means to stimulate a feeling of pride in ownership and to encourage the water collectors to keep the area clean. This approach appears to be accurate and successful, more especially when compared with the condition of non-extended pads as will be discussed later in this chapter.

The shift to theory, practical field projects and laboratory practise, produced program-oriented specialists in which the problem was encompassed by a program involving probes and much investigatory activity but little attention to the root cause of the problem since root causes were rarely part of training.[1] Due to the lack of practical skills, problem-solving and rectification became costly in man hours and in consequence the program orientation became a necessity rather than a trend. Parts on equipment in all fields of application were changed rather than repaired, and even the opportunity for hands-on problem orientation drastically diminished for the more open-minded individual.[2] Problem-oriented specialists are therefore rare and even mor difficult to persuade into a long-term CIDA contract engagement in any developing country.[3]

There remains a serious deficiency in preparing specialists to be both problem-oriented and program-oriented, as required in the projects under study here and many others. In addition, with few exceptions, the equipment supplied on these projects was selected from an ethnocentric viewpoint: what appears to operate satisfactorily in Canada must surely operate elsewhere, and in any instance, the lowest price, and to a secondary degree, the Canadian content level, are the true selecting factors of the equipment available.[4]

On the Upper Region projects, with absolutely no means to communicate outside the country, no general supplies,[5] and very few workshop facilities and tools, it is difficult to confront problem-oriented specialists with inappropriate technology. It is therefore less stressful for Canada-based officials to appoint program-oriented specialists and administrators to such projects. Such specialists will not be aware of the inappropriate characteristics of the equipment supplied and would not demand swift and dramatic changes in CIDA policy, necessary in purchasing, equipment selection, and commercial terms and conditions.

Specialists who are both problem and program-oriented must possess the necessary human qualities, or the adaptability to accept strange, and indeed horrifying conditions, to therefore enable them to ultimately satisfactorily complete these Upper Region projects.

2) The Problem of Fatalism in the Path of Development in the Upper Region:

By contrast, the Ghanaeans of the Upper Region are by no means conditioned or trained to programs; they are good-natured, unhurried, jucular; they value animist tradition, ways of domesticity, and the satisfaction of drinking home-brewed Pito. They have an inherent enjoyment of role-playing, and consider a display of anger in an individual only as an anticipated manifestation of role-playing, never as true and therefore ill-mannered passion. Supervisory personnel, posted in from the forest and coastal regions, occasionally display an officious or regal approach when addressed, but this does not inspire more than a respectfull stance from those responding. The response is in-keeping with the traditional behaviour of Upper Region residents, but does not conform to the stereotype responses anticipated by Western, scientifically-oriented individuals.

As a result, CIDA project personnel have long coined the phrase, "The only eventuality you can be sure of in the Upper Region is that the day will be sunny and the temperature will be around 106 degrees F."

While such Canadian personnel might consider the building or repairing of major highways in Ghana generally as essential to satisfy the world expectations in the development process of a society that tends to think fatalistically, there is a great danger in providing ready access to otherwise untouched rural areas. There is the risk of losing valued ways and artisan skills. This, say the people, can be brought about because the increased access may bring about more lucrative employment for the artisans who are presently in abundance; and because wider distribution of crafts would encourage sales monopolies thereby reducing the varieties of goods produced by the individual, or government-licensed cottage industry. The variety of goods that artisans presently enjoy producing in the community and market-place is limited by existing regional and district isolation.

It may be said, therefore, that the populace of the Upper Region enjoys improved health, especially the children, and they are certainly appreciative of the reasonable and, according to their standards, satisfactory access to clean water which is now made available by the joint efforts of CIDA, the donor, and Ghana Water and Sewage Corporation (GWSC), the recipient. They may, however, not welcome development beyond the present degree of health care. While the Canadians do have problems with the project, they will remain and provide more interest and employment.

Some evidence of this may be briefly summarized, as follows:

a) GWSC management is too young, too inexperienced, and lacking in field application of their respective vocations to cope with the extreme difficulties of hour-by-hour progress of the working day.

b) Generally, and with few though outstanding exceptions, Ghanaeans lack the tenacity required to select and establish the real priorities, both existing and pending. They lack the psychological determination and drive to stay with the socio-technical demands of the project to see it to a satisfactory long-term, rather than interim conclusion.

c) There is a general, though not total, inability of the men to accept responsibility of the task in hand except in traditional tasks such as harvesting. In Ghanaean society it is the boys who run free and the girls who are harnessed to domestic and commercial responsibilities at a very early age. The women are the functionaries and the traders; the men play the parts. The onset of a technical circumstance involving a high degree of preventive maintenance leaves the majority of men totally ill-equipped psychologically. Hitherto society in Ghana has been a man's world. The change has not yet reached the Upper Region, at least.

d) Even with the traditional role of the Ghanaean male in focus, the manifestation of a fatalistic approach by the males is difficult to challenge, because -

(i) those who should be responsible in their work, are almost invariably posted into the staff and skilled-worker personnel establishment in GWSC and all other State corporations represented in the Upper Region. Apart from the unity of strength achieved by pre-negotiated collective agreements, they are in a minority in the Region, and have a strong tendency to sympathize and be supportive of each other in their professional status whether in just cause or otherwise. This view is supported by the fact that while the majority of imported southern Ghanaeans are only nominally Christians, local Christian churches, clubs and societies are 90% composed of individuals and families of the posted community and all are well attended.

(ii) The southern Ghanaeans, being in a relatively closed community, are in the delicate position wherein at a given level, those who vocally criticize a lax colleague, or a deficiency in productivity or responsibility, are then subject to counter and possibly stronger criticism in the close social proximity of their peers.

(iii) By nature and tradition the men, with the exception of those remaining (in Ghana) of the more intellectual groups, animatedly chide each other as part of their general, happy and good-natured social posture. Whatever vocal passion a man or indeed a woman is observed to direct towards an individual, whether equal or subordinate, it is never considered by the victim as being delivered with serious intent, and the outburst is immediately forgotten.

(iv) A reprimand by a superior is viewed by a subordinate as expected from a person acting out the legality of that appointed position; more especially since it is recognized by the subordinate that the superior is appointed by social or political influence, rather than by administrative or technical expertise, therefore, a role is being played. The outburst, however simulated, is appreciated by the subordinate because the verbal communication demonstrates to him that his superior has concern for him and does not reject his presence on excuse of preoccupation in the burdens of his position as is often demonstrated, and with some justification.

(v) The Upper Region is dotted with derelict remains of failed or abandoned projects and the partially completed skeletons of shelved government projects started by previous political regimes. Scattered about in fields, ditches, garages, and yards, are gleaming piles of canibalized new equipment, abandoned through lack of repair skills and motivation; lack of spare parts omitted from the agreement of a donor nation or institution, or sold by an official to a neighboring country to increase his personal foreign currency holdings.[6] It is ultimately difficult to convince all but the most travelled Ghanaean resident of the Region of the purpose of striving for anything but short-term relief of a situation. There is no example available of the need or purpose to strive for quality or performance in a project. All evidence is that any project or piece of equipment will, in a very short time, become inoperable, or will survive only in dilapidated form.

People of the indigenous tribes are well aware that if lifestyle improvements are required by any government of Ghana authority, it will come from those Ghanaeans of other tribes posted into the Region from the south. Recognizing that these temporary residents from the south are infinitely more vocal concerning the difficulties existing in the Region than the CIDA project personnel, it is not likely that the improvements in lifestyle will deter the southern Ghanaeans from exercising their right after five years, to Regions possessing improved facilities for themselves, and especially for their children.

The greatest threats to the CIDA-sponsored water resource projects still in progress in the Upper Region may, in fact, be said to revolve, not primarily from the deficiencies of the Canadian-designed-and-initiated programs, but from the inability of the Ghanaeans at this time to maintain what must be labelled, "the fruits of an inovative Western society". One of the "fruits" of major concern here must be that of learned trade skills essential to the development of comprehensive and consistent maintenance on all industrial and automotive equipment brought into the Region. Herein lies a significant feature of skilled tradesman behavior which must be considered and closely monitored.

Skill-in-isolation Syndrome:

This feature of behavior, displayed by skilled Upper Region GWSC tradesmen which is misinterpreted by Canadian project specialists as fatalism, is what the author has termed, "the skill-in-isolation syndrome". All skilled tradesmen are initially selected from secondary schools and sent to the technical school at Kumasi, capital of the Ashanti Region. They are trained in electric and gas welding; as electricians, pipefitters, motor mechanics, and carpenters. In the group of twenty-two members who were interviewed in these trades, none had any vocational experience prior to entering the technical college. The training was fundamental but sound in the author's view. All trade practise was achieved within the confines of the school - no on-the-job practicum was required.

In developed countries all young graduates from trade-training institutions are exposed to on-the-job experience, either as part of the curriculum or, when first employed, allowing them, with sound basic principles in hand, to gain by observation, example and the pressure of work, to learn the where-with-all and to gain confidence in their skills in the company of those more experienced. In the isolation of the Upper Region this is not the case. The graduate is posted directly to the designated district post of GWSC and immediately finds himself working in isolation and under pressure to succeed from a foreman who has the mandate to complete a task, but who, because of the socio-political terms of his appointment, is totally lacking in the skills to provide the detailed direction to his tradesmen who are working under very difficult material-shortage circumstances.

While the tradesmen operate as a group out of a GWSC district office and therefore have the opportunity to interact on return to base, usually each day, the pan-tribal doctrines of the incumbent government in Accra are not felt at the level of the individual worker. Because of long-standing tribal social differences and the internal politics existing in GWSC, there remains a feeling of distrust and competition. Trade skills and experience are therefore strictly guarded at all times. It is, therefore, very difficult for anyone to interact with or counsel the individual.

The end result of this isolation, both externally and self-imposed, is that, of the twenty-two tradesmen interviewed in private on the job, over a period of seven weeks, was that:-

- for a period of over two of their five-year posting contract, up until the arrival of the author, three of the tradesmen avoided being sent out to work in isolation, due to fear of failure;
- eight tradesmen worked in fear and confusion, and were labeled as "basically incompetent" by their superiors;
- five of the twenty recognized their problem and made efforts to obtain information from fellow workers and were confused but relatively competent;
- the remaining six mastered their trade sufficiently to carry out simple, straightforward tasks.

With the necessary close on-the-job cooperation required between a Ghanaean worker and trained, problem-oriented project specialist, these defficiencies can be easily overcome, but most especially from the recognition of the worker that job stage-by-stage methods and procedures applied and demonstrated by the project specialist, are identical to the training received in the Kumasi classroom.

Cybernetics - as a Component of Community Development:

The problem has been addressed here, of the program mentality applied by CIDA and its designated field representation, in what must be a blend of program-oriented and problem-solving mentality, for what is essentially a make-and-mend society. In contrast, a further problem in the path of community development towards good health is the fatalistic attitude of the Ghanaean people who are involved in, and affected by, the project in the light of administrative staff postings; coupled with the parallel effect of the skill-in-isolation syndrome which exists among catagorically skilled Ghanaean tradesmen. These two problems, while being by nature of serious concern and importance, are to be anticipated in community development. The third problem, which has existed from the specification-preparation stage of this project, has been the absence of formal application of cybernetic principles as they essentially apply to community development. Cybernetics, appropriately applied, would have served in this as a binding feature to overcome, circumvent, and indeed avoid the presence of most of the problems evolving in the project.[7]

The "Father" of cybernetics is generally accepted as being Dr. Nobert Wiener (1894-1964), the American mathematician. He proposed that all purposeful behaviour, whether of living or inert matter, would be studied within the same framework. Wiener announced in 1948 that he had created the new word, "cybernetics", from the Greek word, "kubernetos", (the steersman of a ship), forgetting that the term had been used by Ampere in 1834 in his classification of the sciences to define the sciences of government. The use of the word in this sense reaches back to Plato.

One of the criticisms, and indeed oppositions, to cybernetics is the view that cybernetics consists of no more than a process of analogy-making between contrasting elements. Aptor 1966 (p.21) quotes the criticism of Oparin, who states that,

> "Wiener ... maintains that it is possible to produce a far-reaching analogy between (the higher nervous activity of man and animals) and the work of contemporary, self-regulating machines and automata."

Aptor also points out that the subtitle of Wiener's book is "Control of Communication in the Animal and the Machine", and on this basis the subject of cybernetics has often been described as the comparative study of men and machines. Wiener did more than this and showed that two very dissimilar elements could be discussed in the same language for any "purposeful" system. Wiener was talking of cybernetics as a science of steersmanship, of government, of control. Cybernetics deals with living on inert which may be termed self-controlled. In the case of Third World countries, community development in any form must be primarily and indeed essentially considered as the matching and ultimate blending of two totally polarized cultural elements. The development goals of the donor agency must, for political purposes, remain fundamentally unchanged in intended core purpose. This must be offered phase-by-phase to each recipient community at the micro or village level to obtain reaction and carefully recorded feedback. The process must be repeated on a controlled trial-and-error basis, and the peripheral means to achieve the development aid goal modified to achieve a socio-technical optimum level. It must however be emphasized here that in presenting the core development intent, each village and sub-system community must be dealt with separately with the widening and maturing experience of the field animateurs and the constantly reacting "Bush telegraph" making each approach easier and more congenial. On no account must an aggregate policy towards a group of villages or Kroals be applied even with the agreement or suggestion of the House of Chiefs or similar social group. Otherwise cybernetics is reduced to tokenism.

Cybernetics then, can be applied to community development on the presumption that people within social systems should have an innate urge to minimize the uncertainty of their environment, both on a local and regional basis. There should be an inherent desire to know how and why. People should be constantly carrying out small experiments and using the results to make decisions. The decisions lead to actions and give rise to information feedback paths which in turn provide information concerning the success, or otherwise, of the action taken.

The social systems in the geographical area of study comprise every level of complexity; from the family or primary work group to large-scale formal organizations in the sub-tribal district, to the House of Fra Fra Chiefs, all of which consitute an interacting human community. Primary groups, and ultimately all groups, are composed of self-regulating persons as their components. Large social systems, which in this case is the inter-tribal community found in the area of the Upper Region, normally consist of functional groups in their component sub-systems such as individual villages and communities interacting by way of the respective Naba and his appointed council. The integrated activity of large social groupings is the effective internal communication and a willingness on the part of the decision makers in their component social sub-systems, and ultimately of their component persons, to respond in a predictable and programmed manner to a defined range of perceptual inputs or proposed development goal.

Fundamentally, the model of community self-regulation requires a functional distinction between perception, decision-making and action. The defining of this distinction is the responsibility of Ghanaean field animateurs interceding only if they are requested by the community involved, whether it is a large social group such as the House of Chiefs, or a sub-system led by a Naba and council. It may be said therefore that the function distinction is achieved between receptor elements within the system. As the social systems increase in size and complexity these functions and the related communications functions tend to become concentrated in component social sub-systems such as the Water Utilization Program representing CIDA and the various water pump maintenance and pump-site hygiene-control committees discussed in Chapter IV of this study.

What is being dealt with here, therefore, in the cybernetic approach to community development, is an effect that reacts on the cause that produced it, and that is feedback. When assessed by the project coordinator or animateur, the cause is repeated in a varient form to achieve a further reaction and the essential feedback. As with the human and animal learning process, there is also the essential trial-and-error component of cybernetics mentioned earlier.

Working on premise that learning is necessarily a goal-seeking process and information feedback is inherent in it, the view may be taken that feedback is also essentially learning. In the community development application of cybernetics, the development recipients learn as they formulate feedback in the same manner as the donor agency animateur team must learn as they recognize the need to modify the peripheral means program or to augment the core program. When the donor agency development team receive a feedback positive response from a given situation, a given problem or a reaction to a goal proposal, the chances are that when the same situation, problem or reaction is repeated the probability of positive feedback will improve. Likewise, the greater the frequency of repetition the more likely it is that the team will deal with the situation, problem or reaction successfully. On the other hand, if the feedback response is negative the chances that team will repeat the proposal which brought about the negative feedback, will diminish because the team members have learned from experience.

The essential components of cybernetics as applied to this project are:

1) Goals (Core intention of development)
2) Means to achieve goals (Peripheral element of goals)
3) Trial-and-error proposals (Donor agency team)
4) Recipient reaction (At village grass-roots level)
5) Feedback of reaction
6) Assessment of attainment level and action (Donor agency team)
7) Final matching of donor and recipient goals and the means to achieve them.

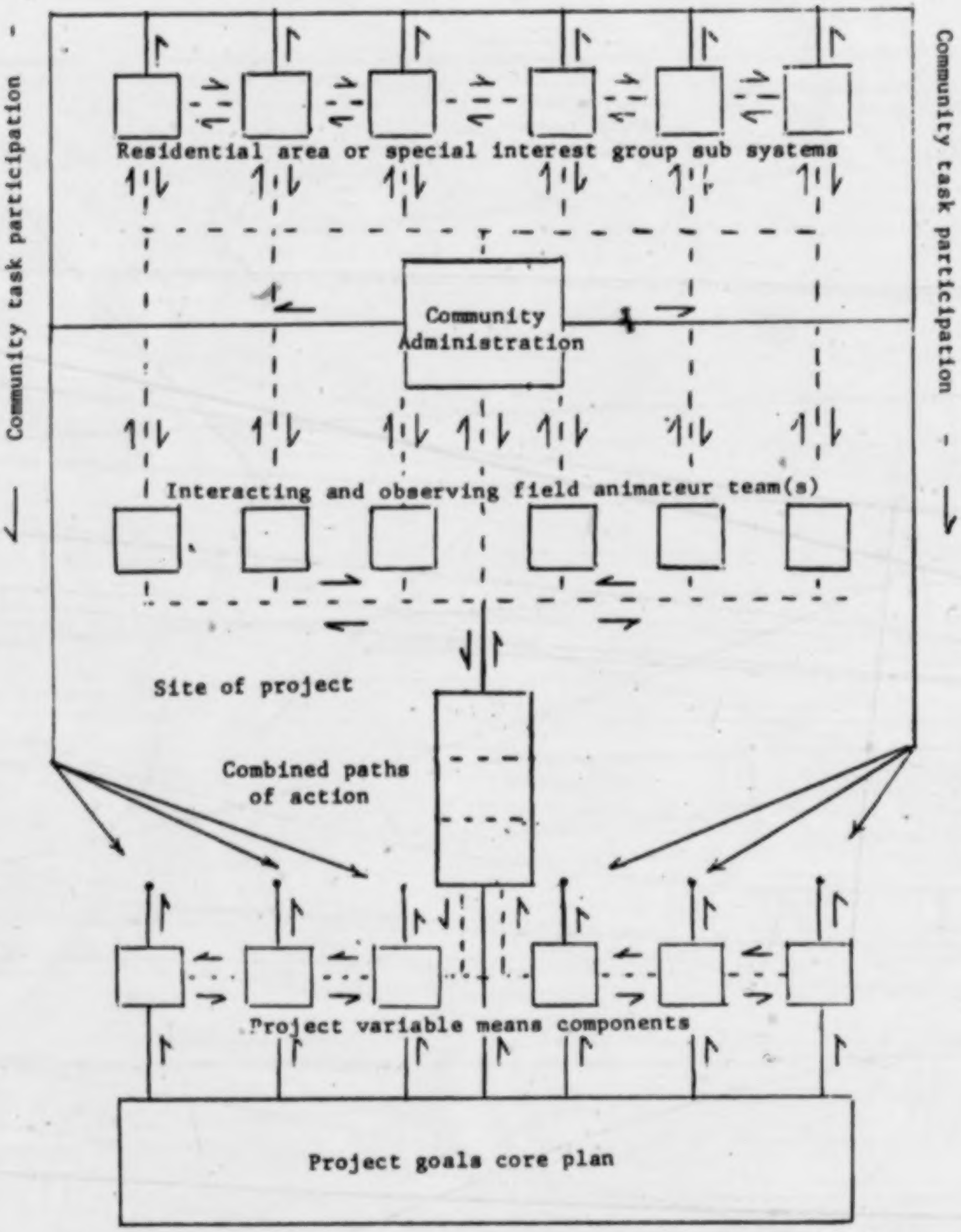
Figure 1 schematically represents the process that should be applied cybernetically in a Third World aid program, while Figure 2 shows how cybernetics should have been applied to this project on initiation.

To illustrate and summarize one of the many examples cited in this study, of how the absence of cybernetics defeated the community health-giving intent of the project, the case of the hand-pump site conditions can be offered.

The goal of the purely technical Wardrop team was to drill a bore-hole, insert a pipe casing, terminate the casing at the top surface of a concrete pad (182.9 centimeters long; 81.5 centimeters wide), and anchor a pre-selected hand pump to the top of the casing by way of studs let into the top surface of the pad. The pad was then back-filled to provide a drainage slope. With this site design known, the CIDA animateurs may have asked the following suggested questions of each recipient group of villages, supported by their own recorded observations of traditional water-site social behaviour.

Fig.1

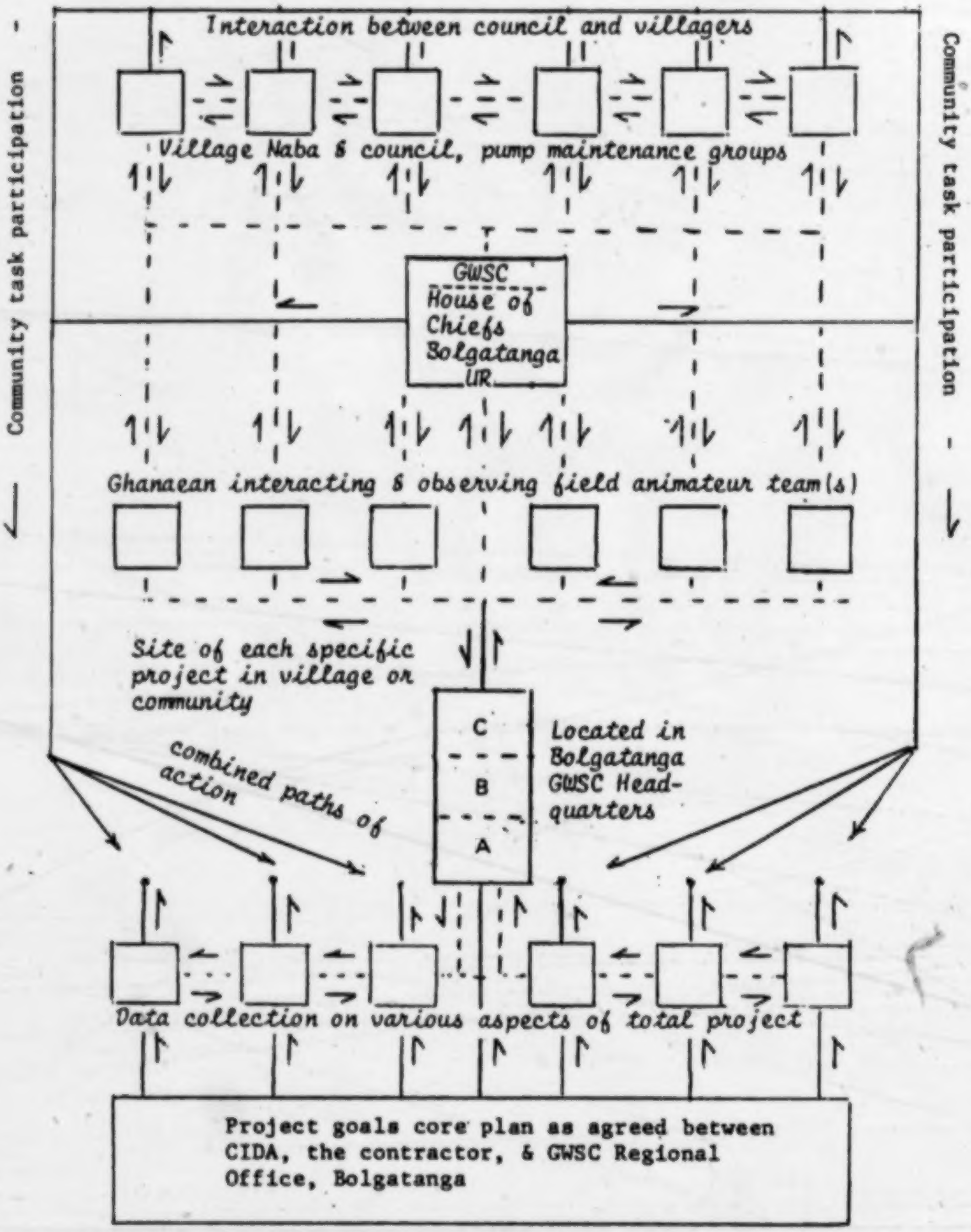
CYBERNETICS APPLIED TO COMMUNITY DEVELOPMENT


Community task participation
Community task participation
Residential area or special interest group sub systems
Community Administration
Interacting and observing field animateur team(s)
Site of project
Combined paths of action
Project variable means components
Project goals core plan

Key A: Project field Socio-Technical coordinator (comparitor)
B: Proposal/feedback criteria assessment
C: Community development animateur team

FIG. 2

CYBERNETICS SUITABLE FOR APPLICATION IN AREA OF STUDY.UPPER REGION.GHANA


Interaction between council and villagers
Village Naba & council, pump maintenance groups
GWSC
House of Chiefs
Bolgatanga
UR
Community task participation
Community task participation
Ghanaean interacting & observing field animateur team(s)
Site of each specific project in village or community
C
B
A
Located in Bolgatanga GWSC Head-quarters
combined paths of action
Data collection on various aspects of total project
Project goals core plan as agreed between CIDA, the contractor, & GWSC Regional Office, Bolgatanga

Key A: Project field socio-technical coordinator (comparitor)
B: Proposal/feedback criteria assessment
C: Ghanaean community development field animateur team supported by non-Ghanaean specialists including WUP staff

The questions are simply typical of the type of catalyst approach needed for cybernetics to flow, and therefore are not listed in any essential order here. The sense of progression into the subject must prevail and the rate of progress must be carefully gauged by the degree of response[8] and the governed assurance that both men and women are equally represented among the respondents. As was mentioned earlier, the Ghanaean men have the authority but the women hold the behavioral key to the success or failure of a water-supply project. It may also be useful to hold a question lacking in clear response to a future occasion to obtain what may be termed, "an opinion in due course".[9]

1) You have seen hand pumps installed in other villages; will you be pleased when one is installed here?

2) The drilling crew must place the pump where the best supply of water can be found. Do you have any concerns about just exactly where the pump will be located?

3) If the pump is installed in these places, will you have problems with other women coming over for water? Do you know the women in other compounds close by?

4) From what you may have heard from other people, do you think this pump water will give you and your family better health?

5) Are other people looking forward to the installation of the pump?

6) We are to install pumps in specific (identified) villages and locations in this area; if your pump should break down, where would you go to obtain pump-supplied water?

7) Canada is supplying help to GWSC by providing drilling equipment, drilling crews, hand pumps and cement pads for this water-supply project. Would you help make the pump site usefully tidy by carrying in stones and gravel to place around the concrete pad?

8) Some women wash and dry clothes near to the water. When the pump is installed it may be that there are no bushes or stone walls or trees nearby to hang the clothes on. What would you do?

9) When the stones and gravel are in place around the concrete pad, how about making a concrete apron to cover the stones (mark out a previously established area suitable to both the site and project budget) to give you a drained area which can be kept clean for washing and drying clothes and bathing children? 10

10) Since the roaming animals contribute to the mess around any water source, they will certainly come to drink from a very accessible place like a water pump-site, we could make a channel in the concrete apron into a concrete trough placed at the edge of the apron to be used strictly by the animals.[11]

11) While we must all save water, especially in the dry season, we can not help spilling some clean water, and there will be the water running down the apron from our washing. If, when we made a concrete apron, we also made other channels into a clay and cement run-off garden, we could grow food the whole year-round, keep it watered without effort and keep the animals out which normally eat and trample the crops.[12]

12) Once the contractors have the pump installed and the water flowing into your buckets and jars, we must try to avoid using the old water sources from which the diseases come. To do this we must keep the pump well cared-for just like a baby. Who shall we choose to take care of the pump?

13) If no one can be found from the community to repair the pump, would you be willing to pay GWSC to come out from town to carry out repairs?[13]

14) How many buckets or jars of water do you carry home each day, and how do you use the water that you take home?

15) If the water source was nearer, would you use more, especially for bathing and washing pots and calabashes?

16) Would you bathe your children more often if the water was plentiful, and would you bathe them at the pump?

17) Do you wash all your pots and calabashes with water, or do you scour some with sand? Would you wash all cooking pots and calabashes if clean water was readily available?

18) Do you keep your stored water pots covered to keep out the dust and the animals?

19) Do you wash your hands after going to the toilet, or do you use your left hand for cleaning yourself and the right hand for eating food ?

20) Are you or any of your family left-handed which would make that traditional rule pointless ?

21) If you or your children are sick would you visit the Ju Ju man, or would you attend the clinics provided by the Christian Sisters, or go to the hospital?

22) If you went to the clinic or hospital for several visits for treatment, do you think your parents, the villager or the Ju Ju men, would be angry and try to stop you from using white man's medicine?

23) Do you think white man's medicine, together with the use of plenty of clean water from the pump, will make you and your family feel and look well and happier?

These questions may be labelled as hindsight in this case but these are the type of questions which were asked by the staff of Wardrop and Associates and the CIDA Water Utilization Project (WUP) team, in due course. Communities were approached when making good the omission of the cybernetic approach was out of reach financially, and for the most part impractical for technical reasons and resistance to change or modification of achieved goals in the expectations of the developed communities.[14]

As has been discussed here, to obtain a full responsive reaction, and accurate feedback in the cybernetic trial-and-error communication and learning process, native animateurs must be employed which immediately provides a foundation of familiarity for a non-national socio-technical coordinator to formulate relevant exploratory questions which will not, as might otherwise be the case, be alien to either the animateur or the respondents. The cybernetic process is therefore flowing internally before it is launched externally into the communities. What appears as a laborious question-and-answer process, fraught with spurious factors, is in fact a dynamic process with answers fed back by animateur/coordinator conference, rather than clipboard data compilation.

From the feedback of such questions, proposals may be submitted for site-work community participation which, if arranged as a successful experience, can lead to proposals dynamically stemming unsolicited from each community or social sub-group in that community. The two major features of assessing counter proposals must be ——

a. Accurate project criteria assessment and how the counter proposal or modification fits;

b. An avoidance of "Take-off" in development enthusiasm beyond the financial, material and physical capabilities of all partipants, while at the same time avoiding burnout and frustration of a people long accustomed to broken political promises, and surrounded by incompleted projects and equipment abandoned by donor suppliers.

There must always be some on-going progress of development to achieve at least a maintenance, if not innovative stance, of the people whether it is the field of pump maintenance, site hygiene, domestic hygiene, or direct receipt of medical preventive and curative treatments.

Recent staff appointments to the ongoing Maintenance and Stabilization Program, associated with both the hand-pump and pipe-borne projects discussed here, show an apparent recognition by CIDA officials in Hull, and a fulfillment of long-term views held by W.L. Wardrop and Associates in Winnipeg, that a more pragmatic, problem-oriented approach must be applied. Programs encompassing urgent rectification of past mistakes and unforeseen political and economic developments are now continually late in CIDA initiation and therefore in provision of funding. If CIDA is to remain representative in the Upper Region of Ghana, then those who represent CIDA in the field must be capable of recognizing that a make-and-mend approach must be applied in all areas of community development, and all efforts must be coordinated for the common good of the people who CIDA has now an ongoing commitment to serve.

CHAPTER VI

FOOTNOTES

1. - All branches of engineering, for example, were in 1950, requiring 2.5 years in Junior Technical School; 1st, 2nd & 3rd year Ordinary National Engineering Certificate, requiring 7 hours of day attendance, and 6 hours of evening attendance at Senior Technical College, and 33 hours of related engineering work satisfactorily recorded each week; two years of Higher National Engineering Diploma arranged as alternating 6 months' full-time attendance at University, and 6 months' full-time employment at related engineering work which must include a high percentage of "out work", i.e., installation and problem-solving outside the shelter of a factory.

2. - Such individuals, classified as direct labor, were prohibited from on-the-job problem-solving to rectify, rather than replace equipment or parts thereof.

3. - This is more especially the case since comfortable housing is provided by CIDA; recreation and medical facilities are non-existant in Bolgatanga; power supplies are intermittent at best; and with Western foodstuffs only available 210 Km distant from Ougudougou in Haut Volta, project personnel are forced to eat native foods at highly inflated local prices.

4. - The ramifications of selecting equipment from the lowest bidder when CIDA is not obligated to do so, is worth a separate treatise. Briefly stated, it may be said that purchasing from the lowest bidder is acceptable only if the CIDA-appointed consultant has issued a

4... - "tight specification", i.e., one that is precise and detailed, to allow no loopholes. This is difficult if the specification is to be democratically impartial, and only possible if the consultant is a long-term CIDA appointee and therefore well-versed in appropriate technology for a given socio-technical environment.

5. - When on the project, the author must wisely collect and guard rare washers, bent nails, corroded nuts, bolts, and pipe fittings, together with pieces of string and wire.

6. - This type of corrupt activities, at the loss to the state, and to the major benefit of the individual, was one of the primary reasons for the second coupe of Flt.Lt. Gerry Rawlings. The smuggling of new donated equipment, stolen from the state and sold for foreign currency to Nigerian contractors working in the oil fields, was common and blatant. To enter or leave the country, it was simple for an articulate truck driver to bypass the check points by driving through the clear savanah range land. If the truck was sighted, there were no working telephones and no transport to pursue. By contrast, the number of effective check-stops, system of documentation, and telephone systems, make any form of smuggling difficult and dangerous in the neighboring francophone state of Haut Volta.

7. - The cybernetic approach was proposed and accepted by CIDA implementation in the Northern Region Rural Integrated Program (NORRIP) by the W.L. Wardrop-Delloitte joint venture in Tamale, 180 Km south of Bolgatanga in the Northern Region of Ghana. Goals based on a total community development integrated program agreed between CIDA and a Ghanaean project coordinator were, and continue to be, cybernetically negotiated successfully in Tamale and district by a socio-technical teams of field animateurs supported by a resident Canadian.

7... - team composed of both technical and sociological specialists. In the four years this approach has been in operation the teams have achieved wide grass-roots support in the promotion of self-help or what should be better described as the kind of participatory democracy fortunately advocated by the incumbent Rawlings administration. Inter-tribal warfare resulting from fertile land and fresh water rights have ceased as the local residents achieve an active understanding of development goals considered appropriate and desirable for a given area.

8. - As an on-site example of the appropriate approach to a cybernetic policy in the Upper Region, questions must be posed in conversational form and should not be recorded as a questionaire. Actual responding comments should be recorded, together with a note on the attitude of the response. The usual clipboard and tape recorded armourment of the animateur should be out of sight since the Ghanaean nature leans towards role-play. Tape recorders, while being the obvious tool, have the problem of battery replacement; there has been an absence of dry-cell batteries for over a decade in all parts of Ghana. Meetings should never be called by the animateur, the Naba should retain that proper privelege. If a meeting is called by the Naba, all questions must be asked through him, or of the person he may delegate the task. The advantage of a meeting called by the Naba is that protocol is observed. The disadvantage is that the males will role-play; the women will for the most part keep their place and remain silent. The better meeting place for interaction is sitting by the more heavily-used water sources and visiting the larger compounds in a village or residential area. In all cases the Naba must first be visited in his palace, preferably with an offical of GWSC to provide the authority and relevance.

9. - True responses will rarely be conveyed to a white man. In the case of the more primitive Fra Fra tribe, only members of a Fra Fra community or neighboring friendly tribe would be effective as animateurs for the cybernetic approach. Since a reasonable percentage of Kassena, Nankani and Dagarti Speak and write English well, there are both male and female candidates available trained in Roman Catholic schools stemming from Navrongo centre. Ghanaeans originating from southern tribes such as the Ga and Ashanti are regarded by both Northern and Upper Region tribal communities as if they were whites. Representatives of religious orders and those whites who may assist them or provide separate educational, medical or technical advice are very well accepted, but the social and possibly class barrier remains to block the exchange of personal fears, concerns and perplexities of the majority of individual villagers and family groups. All this type of viewpoint must be considered in obtaining each sequential phase of reactive response for the cybernetic approach to be effective and the trial-and-error process to remain both progressive and comprehensive to all parties involved in the project.

10. - The use of clay and vegetable dye-urine mixture to glaze, color and waterproof the walls of mud buildings has been applied for some centuries, mainly stemming from Ashanti practice. Since the construction of the cement plant at Tema the Ghanaean government have, with the assistance of funds from donor nations and NGO groups provided one bag of cement to each child regularly attending school to facilitate water proofing buildings at the onset of the October/June dry season (when unglazed walls crack while providing an incentive for rural families to educate their children in state-registered schools. The people were therefore well aware in 1974 of the uses and forms of concrete structures.

11. -If community agreement is reached on factors 9 and 10 the drilling crew would then have made available reinforcing bars and tie wire to properly join the basic concrete well-head pad to the agreed extra apron and to construct a crude water trough. Some of the men having worked on building projects in the more affluent days had become semi-skilled masons, and with the cessation of construction, had returned to their respective villages.

12. -It is an interesting phenomena in the Upper and Northern Regions at least that since there is land ownership by tacit acceptance rather than deed of ownership, there follows a social understanding that he who sows shall reap the fruits thereof. One finds therefore patches of ground nuts planted along road sides which in general remain untouched by the many passing pedestrian travellers in favor of the unknown sower. Therefore while the community garden fosters connotations of community conflict, those participating in such a garden worked well together, both in effort and distribution.

13. -This was an essential and logical question to be agreed upon at the onset of this project; at this time, no matter what repair funds are made available, there is insufficient fuel for GWSC staff to be transported to remote sites and, as mentioned earlier, the mail service has broken down and a requirement for repair notification can not be sent in any form. Had the matter of pump repair and preventive maintenance been addressed immediately the project started, a large number of local individuals would have received both training and experience. They then could, like other local tradesmen, become self-employed contractors as part of the community development.

14. -For example, the drilling of concrete pads to insert re bars would probably crack the pad. Much more back-fill would have to be brought in by hand to support an apron. If an apron was poured without re bars then it would soon ease away from the separate pad and create a sewage trap. Of greater relevance is the strong possibility that the women at least would object to modifications to the principle of water supply and would resist change.

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